Using and applying mathematics : innovation and change in a primary school.

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innovation and change in a primary school

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Abstract

'Using and Applying Mathematics' was introduced and made mandatory as part of the mathematics National Curriculum in England and Wales in 1989. This section of the curriculum focused on process-based aspects of mathematics. Previous research has indicated that many primary teachers found it difficult both to interpret and to implement the requirements of 'Using and Applying Mathematics' in terms of their own practice.

Taking account of evidence from the literature of the long term nature and complexity of the change process in education, this research has taken the form of a two year case study in a primary school which had already declared an intention to develop these process-based aspects of the mathematics curriculum. The school's mathematics development has been investigated using qualitative methods of data collection and analysis. Teachers voices are heard through interviews and observations of their classrooms, whole-school and group meetings, and informal professional and social interactions. Whole school objectives and strategies are charted through observations recorded in fieldnotes and the study of school documents.

Theory informed both data collection and analysis, and was, in turn, informed by insights gained during this case study. The data provided rich descriptions that illuminated three issues of particular relevance to the change process: the nature of 'Using and Applying Mathematics' itself and the challenge it presents to established ideas of 'primary school mathematics'; the singular nature of each individual teacher's response to the development of this aspect of mathematics, with beliefs and understanding of mathematics as well as personal and career factors all playing a part; and the complex nurturing role which the school must engage in if teacher development is to be fruitful for all those involved. These issues retain their critical importance in the situation of disquiet and uncertainty that currently surrounds primary mathematics.

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My family have supported me throughout, never doubting that the thesis would be completed, and that confidence has helped me greatly.

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Introduction

If we still regard change as a simple event, to be initiated by those responsible for policy and implemented by those responsible for practice, we have failed to take notice of the volumes of research and writing on educational change which have informed us over the past few years. It appears, however, that policy makers still cling to ideas of top-down reform as an effective way of initiating change. Those responsible for the major educational changes of the past eight years - the introduction of the National Curriculum in England and Wales and its accompanying statutory assessment system, the revolution in the financial status and accountability of schools - were looking for results within a very short time-scale.

An interest in innovation in primary education has developed for me over years of experience as a primary teacher and as a mathematics co-ordinator, deputy head and acting head, and was further fuelled by participation as a Research Fellow in the Evaluation of the implementation of National Curriculum Mathematics, 1991-93, (Johnson & Millett, 1996). This evaluation, commencing two years after the National Curriculum was introduced, raised issues again of the complexity of teacher development and change, particularly with regard to 'Using and Applying Mathematics', now mandatory as part of the mathematics National Curriculum - issues which I wanted to investigate further.

The relevance of both individual and collective contributions towards, and responses to, change, and the tensions existing between these two which I had noted during my experience in primary management, required a focus which could take account of individual teacher development within a whole-school context. It also required in-depth work over time.

The complexity of change lies at the heart of this work. For this reason the literature base is not to be found in one, well-defined, area; its essence is breadth, rather than depth, encompassing three core areas - general theories of educational change, collective responses to change at school level, the development of individual teachers' beliefs about mathematics and its teaching - but also drawing from other related areas where appropriate. In essence, therefore, it is a large canvas painted in broad brush strokes, rather than fine lines on a miniature.

Chapter 1 sets the context for the research in terms of the recent background to changes in primary education and, more specifically, primary mathematics. Chapter 2 presents

an overview of the literature, focusing on the more general theoretical underpinning of the work, leaving further chapters to develop those areas of literature of particular relevance at different points in the analysis. Chapter 3 gives an account of the driving questions behind the research and the translation of these into research design, data collection and analysis. In Chapter 4, the reader is introduced to the school that has been the subject of this case study.

An organic metaphor has been chosen to describe the process of analysis - a metaphor of the school as a vegetable with layers that can be peeled back to reveal, at its heart, the individual teachers working with pupils in the classroom, their ideas, beliefs and practice. Chapter 5 presents an analysis of the school as a whole, its culture and its chosen ways of working. Chapter 6 peels back a layer to look at the work of groups within the school, and Chapters 7 and 8 reveal the heart - the individual classroom teachers and their responses to change. Chapter 9 draws from the preceding four chapters to illuminate three singularities of crucial importance to the process of change: the singular nature of the innovation itself; the singular nature of its meaning and relevance to individual teachers, and the singular nurturing role required from the school. Chapter 10 looks back at the research questions in the light of the current context of national debate about the teaching of mathematics.

Chapter 1. The research context

1.1 Introduction

The context for this research developed in the years leading up to the introduction of the National Curriculum in England and Wales in 1989 and during the early days of its implementation. The first chapter of the thesis covers this ground. Within the more general context of major educational reform culminating in the introduction of a mandatory national curriculum, this chapter looks specifically at the genesis and development of Mathematics in the National Curriculum (Department of Education and Science (DES)/Welsh Office (WO), 1989a) and, within that, at the incorporation of an emphasis on the processes involved in the teaching and learning of mathematics - emerging eventually in the curriculum document as 'Using and Applying Mathematics'.

The results of an early evaluation of the implementation of National Curriculum Mathematics (Askew et al., 1993) are then discussed. This evaluation reported on some of the difficulties being experienced by teachers in implementing the process aspects of mathematics, and identified the need for development in this area. Extending the context to include other radical changes in school governance and management also introduced by the Education Reform Act of 1988 (Great Britain (Education Reform Act), 1988), the increased role of the whole-school in curriculum and teacher development is outlined. A synthesis of these two aspects of the educational background provide the immediate context for the research.

1.2 The development of Mathematics in the National Curriculum, 1989

Calls for a more centralised curriculum for British schools had been gathering pace some years before James Callaghan's 'Great Debate' Ruskin speech in 1976, which promoted the idea of a national consensus on educational aims and policies and drew attention to 'arithmetical shortcomings' in recruits, noted by industrialists (Brown, 1996). This speech was followed by a green paper 'Education in Schools: A Consultative Document' (DES, 1977a) which broached the idea of a 'core curriculum' and approached the development of this idea through a request to Local Education Authorities (LEAs) in Circular 14/77 (DES, 1977b) to undertake their own curriculum review in partnership with their teachers.

Both the Department of Education and Science (DES) and Her Majesty's Inspectorate (HMI) involved themselves in discussion of curriculum matters. Lists of content objectives for mathematics began to appear and became more prescriptive (DES/HMI, 1979). The next major landmark in the development of the mathematics curriculum was the report of the Cockcroft Committee (Cockcroft, 1982), set up in 1978 to inquire into the teaching of mathematics, a report which was "a model of consensus, and set recommendations which were widely accepted both in Britain and abroad" (Brown, 1996, p. 6). The report included a Foundation List of basic mathematical competencies, but the committee managed to retain breadth of curriculum within this content and a narrow focus on number skills was avoided. Variation in methods of teaching and assessment to include practical work, problem solving, investigation and discussion (see Section 1.3) were also stressed, as was differentiation. At the primary level, the DES-funded advisory teachers appointed in LEAs to spread good practice were probably the most important disseminators of the recommendations of the Cockcroft Committee.

The 1985 white paper 'Better Schools' (DES/WO, 1985) gave notice of the Government's intention to set in motion a wide range of educational reforms; centrally determined attainment targets for the end of primary education were to be developed; some form of curriculum definition was in prospect, as were reforms to school government and action to improve teacher quality. Fowler (1990) wrote later:

> The 1985 White Paper was to mark the end of a lengthy period of discussions by the political parties on the possibility and desirability of some form of common curriculum which could be adopted at national level and it heralded the definitive central action which was to occur two years later. (p. 14)

From this time onwards, the pace of change increased and coherence inevitably declined: working groups had less than a year to come up with recommendations; consultation was set in motion over the times when schools and other educational establishments were on holiday. As far as mathematics was concerned, the decision to implement a national curriculum and associated assessment was taken before a feasibility study (Denvir, Brown & Eve, 1987) set up to inform this decision had reported.

The Mathematics Working Group, set up in July 1987, had to deal with a demanding agenda and internal conflicts within a short time scale (Graham, 1993 . Decisions about the content of a mathematics curriculum were to prove less problematic than both those about process aspects of mathematics (see Section 1.3) and those about the allocation of content and process to profile components (PCs) for assessment and reporting purposes.

After much disagreement, concession and compromise, the final consultative document, now the responsibility of the National Curriculum Council (NCC), which had been set up under the Education Reform Act (ERA) of 1988 (Great Britain (Education Reform Act), 1988), consisted of 14 attainment targets (ATs), separated into two profile components, each including a target concerned with processes in the content areas specified (ATs 1 and 9). A programme of study (PoS) which was an almost identical copy of the statements of attainment (SoAs) but presented in a levelled format, was inserted at this stage (NCC, 1988). This version of a curriculum document, largely unaltered, became Mathematics in the National Curriculum (DES/WO, 1989a), circulated to schools for implementation in Years 1 and 7 in September 1989. The NCC also decided to issue non-statutory guidance (NSG) aimed at helping teachers with the implementation of the new curriculum. In this document (DES/WO, 1989b) the opportunity was taken "to resurrect the set of radical principles guiding selection of classroom activities which had been part of the original programme of study. Similarly the guidance on calculation strategies and curriculum planning were far more forward looking than the statutory curriculum ... " (Brown, 1996, p. 25).

1.3 'Using and Applying Mathematics'

For some time before the introduction of the National Curriculum, the mathematics education community had been advocating that the primary mathematics curriculum needed to move away from a narrow focus on basic techniques, in particular operations upon number, and give more attention to mathematical thinking processes and problem solving (see for example Biggs, 1972; Mason, Burton & Stacey, 1982; Skemp, 1978). 'Mathematics' 5-11: A Handbook of Suggestions' (DES/HMI, 1979) had included an emphasis on understanding, reasoning and communication along with a fairly prescriptive list of content. 'Mathematics counts', the report of the Committee of Inquiry into the Teaching of Mathematics in Schools (Cockcroft, 1982) had drawn attention to the importance of problem solving and investigational activities:

> The ability to solve problems is at the heart of mathematics. Mathematics is only 'useful' to the extent to which it can be applied to a particular situation and it is the ability to apply mathematics to a variety of situations to which we give the name 'problem solving'. (Paragraph 249)
>
> The idea of investigation is fundamental both to the study of mathematics itself and also to an understanding of the ways in which mathematics can be used to extend knowledge and to solve problems in many fields. (Paragraph 250)

Her Majesty's Inspectorate (HMI) in 'Mathematics from 5-16' (HMI, 1987) developed the strategies, defined by Cockcroft as "procedures which guide the choice of which

skills to use or what knowledge to draw upon at each stage in the course of solving a problem or carrying out an investigation" (Cockcroft, 1982, Paragraph 240). HMI included as strategies the ability to estimate and approximate; the use of trial and error methods; the ability to simplify a complex task, to look for pattern, to reason, to make and test hypotheses and to prove and disprove generalisations. Personal qualities such as the development of good work habits and a positive attitude towards mathematics were also discussed in this document.

Broader teaching methods which approached investigative work as a way of learning content as well as process were encouraged, at secondary level, by initiatives such as the LAMP (and its successor the RAMP) project (West Sussex Institute, 1987) and also by the introduction of coursework as a future GCSE requirement, although in the latter case, the retention of fairly traditional content examination papers led to investigations being regarded as something of a separate entity, a 'bolt-on' addition to the curriculum, rather than something 'built-in' to the learning of content.

At the primary level, many LEAs had worked on new mathematics guidelines based on HMI objectives (DES/HMI, 1979) and Cockcroft recommendations (Cockcroft, 1982), and these guidelines were promoted by primary advisory teachers. However, these initiatives, together with other work in this area (most notably the Primary Initiatives in Mathematics Education project, 1985-89, (Shuard et al., 1990) launched by the School Curriculum Development Committee and completed under the auspices of the National Curriculum Council), did not appear to have produced much change in classroom practice. The large-scale adoption of commercially produced mathematics materials which followed the content guidelines but gave little emphasis to process skills may have impeded change in this area.

The version of a mathematics national curriculum submitted by the Mathematics Working Group in August 1988 contained 15 attainment targets. Three of these were collected together under the title of 'practical applications' and consisted of 'using mathematics', 'communication skills' and 'personal qualities'. These three were retained together as PC3 for purposes of assessment and reporting. The allocation of statements of attainment (SoAs) to levels within each attainment target proved a particularly intractable problem in this profile component and resulted in these statements being levelled at each age, rather than in 10 levels as for the other attainment targets.

Although consultation generally supported the existence of a separate PC3, the NCC removed it in a gesture of compromise to those who considered it vague and difficult to

assess. 'Personal qualities' was replaced by what was later to be 'reasoning, logic and proof' and the NCC chose to combine these three attainment targets to make one additional target within each of the other two profile components. The resulting ATs were called 'Using and Applying Mathematics in number, algebra and measures' (AT1) and 'Using and Applying Mathematics in shape and space, and handling data' (AT9) and were to be about using knowledge, skills and understanding from these areas of mathematics in practical tasks and real-life problems.

The first mathematics Order produced by the National Curriculum Council in 1989 (DES/WO, 1989a) therefore consisted of 14 attainment targets (ATs), largely unaltered from the consultation document (NCC, 1988), but with a significant change. The subhead for ATs 1 and 9 now included an explicit reference to investigating within mathematics itself. For example, the wording for AT1 now read "Pupils should use number, algebra and measures in practical tasks, in real-life problems, and to investigate within mathematics itself" (p. 3). This Order was supported by the publication of the non-statutory guidance (NSG) in which using and communicating mathematics were emphasised, but in which a third aspect, that of "developing ideas of argument and proof", was also addressed (DES/WO, 1989b, p. D2).

Relationships between the ATs were described in the NSG and suggestions provided for implementation. Both the content of the ATs and the NSG made it clear from the outset that ATs 1 and 9 were different from the other twelve targets: while ATs 2-8 and 10-14 contained "the statements of attainment which describe the stages of progression in knowledge, skills and understanding for pupils at different stages and of different abilities" (DES/WO, 1989b p.D1), ATs 1 and 9 were to do with "using and applying the knowledge, skills and understanding contained in attainment targets 2-8 and 10-14 and their associated parts of the programmes of study" (DES/WO 1989b, p.D1).

The vision of how ATs 1 and 9 should be implemented was encapsulated in the following quotation from the NSG.

> Using and applying mathematics ... should stretch across and permeate all other work in mathematics, providing both the means to, and the rationale for, the progressive development of knowledge, skills and understanding in mathematics. (DES/WO 1989b, p.D3)

1.4 Mathematics in the National Curriculum, 1991

Due in part to lack of understanding on the part of the School Examinations and Assessment Council (SEAC) of the limitations of assessment (Brown, 1996), which led to unreasonable demands for the reporting of levels in each of the 14 attainment targets, second versions of both the mathematics and science National Curriculum were set in motion, the requirement being to make changes to structure rather than to content. This was deemed necessary in spite of the fact that only 18 months had elapsed since the introduction of the first version; little thought appears to have been given to the effects on teachers and schools at a time, for primary teachers, when the full range of curriculum subjects was coming on stream.

The revision of the mathematics Order (DES/WO, 1991) reduced the number of attainment targets from 14 to five, ATs 1 and 9 being combined to form one attainment target, now known as mathematics attainment target 1, Ma1. This new AT retained the spirit of the old 1 and 9, still containing the three strands of application, communication, and reasoning logic and proof, which had been identified as constituent parts of ATs 1 and 9. Ma1 was still called 'Using and Applying Mathematics', but a reference to personal qualities had reappeared and been added to the subhead. "Pupils would be expected to use with confidence the appropriate mathematical content specified in the programmes of study relating to the other attainment targets" (DES/WO, 1991, p. 1). A supplement to the NSG made it clear that work related to Ma1 was still not to be tackled in isolation from the rest of the programmes of study, and work related to Ma 2-5 could not be satisfactorily pursued independently from that related to Ma1. In other words, Ma1 was still meant to permeate and underpin the curriculum. Mathematics Attainment Target 1 (Ma1) 'Using and Applying Mathematics', and the associated programme of study, required teachers to make provision for pupils to engage in non-routine mathematical activities located both within mathematics itself and in 'real-life' contexts.

1.5 Initial reactions to Ma1

The inclusion of Attainment Targets 1 and 9 (now Ma1) in the 1989 mathematics Order produced a variety of responses. For some teachers, the development of 'Using and Applying Mathematics' (UAM) as a necessary and valued part of the mathematics curriculum was long overdue; they did not need to be convinced of its value, indeed they were practising a problem-solving approach in their own classrooms, and were familiar with the aims of all aspects of these two attainment targets. These teachers were more likely to be working in the secondary arena as mathematics specialists,

although many primary advisers had continued to promote the aims of UAM through their work in schools and teachers' centres.

For other teachers, however, particularly at primary level, reactions were different. They had mostly viewed the mathematics curriculum in purely content terms, and the idea of process skills which were supposed to "stretch across and permeate all other work in mathematics" (DES/WO 1989b, p.D3) was new to them. While familiar with most of the mathematics National Curriculum, with a few obvious exceptions in the areas of probability and algebra, their familiarity did not extend to the language of communication and reasoning, logic and proof required by ATs 1 and 9. They may never have considered the issues raised by Ma1 in their mathematics teaching, and the resources which they had been using for years did not, in the main, raise the issues for them. Many primary teachers, feeling that their strengths did not lie with mathematics, had relied almost exclusively on published commercial schemes as mediators of the mathematics curriculum.

If teachers had found these commercial schemes successful in the past, there was no reason to suppose that this reliance would change with the introduction of the National Curriculum, particularly at a time for primary teachers when so many other subjects were demanding their attention. However, commercial schemes did not (with some exceptions) help them greatly with ATs 1 and 9, and although efforts have been made by publishers since the first mathematics Order was produced to incorporate work related to what is now termed Ma1 with the introduction of the new Order, these efforts have tended to be in the form of either 'bolt-on' activities, or claims of invoking Ma1 by 'real-life' contexts (Millett & Johnson, 1996). Such efforts may be more the result of constraints on publishers, than lack of vision. Publishers have experienced serious difficulties in planning for future publications when alterations have been made to the curriculum with little concern for lead-times for new materials, and the provision of these materials has unavoidably lagged behind the need for them.

The mandatory nature of all parts of the curriculum meant that teachers could not ignore these attainment targets, but had to try to address these unfamiliar issues as best they could. Evidence collected by both the National Curriculum Council (NCC, 1991a) and Her Majesty's Inspectorate (HMI, 1991), indicated a limited take-up of these ideas, with teachers having difficulty in interpreting the statements of attainment (SoAs) of ATs 1 and 9, particularly in terms of identifying progression.

> While investigative and problem-solving aspects of mathematics have at least been firmly marked on the English and Welsh curriculum map, the extent to which these process aspects are manifesting themselves in the landscapes of classrooms is still open to question. Evidence so far suggests that the implementation of these aspects of the curriculum is limited and teaching practices in mathematics little changed as a result of the legislation. (Askew, 1996, p. 100)

1.6 Evaluation of the implementation of National Curriculum Mathematics at Key Stages 1, 2 and 3

One of the tasks of the National Curriculum Council set out in the Education Reform Act (Great Britain (Education Reform Act), 1988) was to keep all aspects of the curriculum in maintained schools under review. This monitoring role included not only that undertaken by the NCC itself, but also the commissioning of research, as appropriate, to fulfil this responsibility for review. In March of 1991 the NCC issued a 'Specification to Outside Agencies for the Evaluation of the National Curriculum Core subjects - English, Mathematics and Science at Key Stages 1, 2 and 3'. Four areas were identified as being of particular concern in mathematics: difficulties encountered in the implementation of selected topics; inappropriate progression in the programme of study (PoS) and the ATs; implementation of Ma1, 'Using and Applying Mathematics', and the effectiveness of the PoS for in-school planning. A proposal for a two year project to address these areas of concern and related issues and questions was submitted by the School of Education (then Centre for Educational Studies), King's College, London (Johnson & Millett, 1996) and accepted by the NCC. The aim of the project within the third of these areas of concern, 'Using and Applying Mathematics', was to investigate the difficulties for teachers that had been noted, even as early as 1991, in the implementation of ATs 1 and 9 (as they then were), and to identify promising practice in this area.

1.6.1 The research

The project (referred to henceforward as the Mathematics Evaluation Project) was funded by the NCC and involved the collaboration of researchers from King's College London (Centre for Educational Studies), the University of Birmingham School of Education, and the University of Cambridge Institute of Education. Data collection was by questionnaire survey (to 1100 teachers in 11 LEAs with a 68% response rate); by in-depth interview (with 32 teachers at Key Stages 1, 2 and 3); through case studies in a small set of schools, and through the work of two teacher groups meeting together monthly during the two years of the project. Each of these data sources informed, to a

different degree, the work of the project focusing on 'Using and Applying Mathematics', but the primary data sources for this part of the study were the questionnaires, the interviews and the case studies. Teachers were asked in interview to describe some work in their classrooms which they considered to be related to ATs 1 and 9 (the interviews were conducted before the second mathematics Order became statutory), and to discuss how typical this was of the way in which they approached this part of the mathematics curriculum. They were also asked about their views of the relationship of ATs 1 and 9 with other attainment targets, and about progression within 'Using and Applying Mathematics' itself.

1.6.2 Ma1 - teachers' interpretations

Early findings of the project (Askew et al., 1993) indicated a discrepancy between teachers' own reporting of the extent of implementation of Ma1 and the HMI and NCC findings of limited take-up.

Analysis of the questionnaire data suggested that, particularly in Key Stage 1 and Key Stage 2, the majority of respondents did not regard coverage of 'Using and Applying Mathematics' as particularly problematic, although a substantial proportion of teachers did indicate that they perceived some difficulties in the implementation of Ma1. These difficulties included a lack of teaching experience in Ma1; inadequate coverage by commercial schemes; lack of clarity in the meaning of SoAs and programme of study (PoS); difficulty in classroom management and organisation for Ma1 at Key stage 1 and Key Stage 3, and difficulties related to the need for changes in teaching style. Questionnaire data also revealed that few teachers used the non-statutory guidance frequently or rated it highly for planning purposes.

A consideration of the interview data gave some indication of possible reasons for the discrepancy between teachers' perceptions and HMI and NCC findings on take-up of Ma1 (ATs 1 and 9); there appeared to be wide variations in teachers' interpretations of this attainment target, with many teachers making interpretations which fitted with their current practice. Primary teachers used the terms 'practical' and 'relevant' frequently in association with Ma1. Although these terms might imply that teachers were working to fulfil the requirements of the document to engage pupils in using and applying their mathematics in practical tasks and real-life problems, there were indications that even these terms could be interpreted in a variety of ways. The following sections draw heavily from the writing of Askew (Askew, 1996), with whom I worked in close association during the Mathematics Evaluation Project.

1.6.2.1 'Using and Applying Mathematics' as 'practical' mathematics

The use of practical work as a means of implementing Ma1 was frequently mentioned by interview teachers. Whereas some practical activities, like baking cakes, apply the use of measures, many of the examples discussed by teachers in interview had more of a sense of starting with a piece of mathematical content and then finding some means of making it practical by embodying it either within physical materials, diagrams, or within some sort of 'real-world' context. Examples of 'practical as embodiment' included using tape measures to find numbers, using pebbles for sorting, asking children what position they were in when lining up, drawing fraction 'cakes'. Many of the teachers describing such an interpretation of practical work reported high percentages of time spent on using and applying. This Reception teacher indicated that she considered more than 80% of her mathematics to involve Ma1.

> *Using maths in everything, yes. I mean we have a brick, a plastic brick for each child and I divide the whole class into four teams ... so each child has got a plastic brick and they're in four colour sets and then when somebody is away we put the plastic brick on the side, so we've got a very visual, very large scale representation of who's here and who isn't.*

In a cooking activity, there is a purpose in the use of measurement which can be clearly appreciated by children. Many of the examples of practical work given, however, did not seem to require this sense of purpose. For example, this Key Stage 1 teacher, asked whether she could recall an example of a recent activity which involved the children in using and applying their maths, replied:

> *Um, not recently, but off the top of my head, they had to measure a variety of parts of their body and record the answers. They were given a tape measure ... and asked for circumferences round their head and foot sizes and shoes and they just had to go away and record their answers.* (Year 2 teacher)

Examples of Ma1 which included the application of mathematics in other subject areas, usually involved some physical activity, and frequently had some end product, such as a piece of art work, or a model.

> *... we did quite a lot of art work out of symmetry, that was quite good ... again the art work came from the maths, but I suppose it doesn't really matter ... we used and applied the maths that we'd learnt in the classroom to do the art work ... which was quite nice.* (Year 5 teacher)

In some cases there did seem to be an assumption that physical activity would lead to mathematical thinking, without intervention from the teacher.

> *Using and applying maths, let's see, what they enjoy doing is measuring each other, they love measuring each other, or weighing each other or going round*

asking each other questions about how many people they've got in the family, or what sort of car they've got. They like doing that. (Year 1 teacher)

Examples of UAM which focused on practical activity were common at Key Stages 1 and 2. Many of these involved measurement, or the use of everyday classroom events.

1.6.2.2 'Using and Applying Mathematics' as 'relevant' mathematics

'Using and Applying Mathematics' was also exemplified in activities which might have some utilitarian value for children; mathematics which they might need in their everyday lives. Everyday applications like money or measurement in its various forms and day-to-day numeracy were given as examples of making mathematics relevant to children.

Oh, things like shopping lists or adding and dividing and making averages, rounding up and approximating things like that, I think if you can't relate it to life they don't get the meaning of it

(Later) *I think its just that I try and make it relevant, and try and make it so that they can see what's happening to them, maybe away from school at home.* (Year 5 teacher)

Askew drew out two other meanings of 'relevant'. The first of these involved 'disguising' the mathematics (Askew, 1996, p. 104) in activities drawn from outside school.

They're using number work in the shop, when they're adding up the prices. I mean I gave them little shopping bills that they had to give to another person, so they're actually doing number work there. Simple addition and subtraction not realising that they are doing it, six take away six or whatever, but they are actually using their number work. (Year 2 teacher)

The second involved an assumption that children would find an activity relevant because real objects were used (or conjured up), whether or not the activity itself had real meaning or purpose from the children's point of view.

I think it's just that I try and make it relevant, and try and make it so that they can see what's happening to them, maybe away from school, at home. I'm heavily into Smarties and toffees. Anything that they can sort of visualise and think "oh yes, I fancy that so... ." (Year 5 teacher)

Askew (1996) pointed to a potential conflict between interpretations of relevance in terms of applicability to everyday life, and relevance in terms of being intellectually engaging.

1.6.2.3 'Using and Applying Mathematics' as 'stand alone' investigations

Other teachers interviewed for the Mathematics Evaluation Project were most likely to be using investigations as a vehicle for the implementation of Ma1. These teachers were mainly working at Key Stage 3. The influence of GCSE coursework was evident here (see Section 1.3) in terms of previous experience, as was the current need to provide opportunities for the assessment of Ma1. Several departments had realised the need to develop the diet of investigations for their pupils, but they were still seen in many cases as 'bolt-on' additions rather than integral parts of the mathematics curriculum.

1.6.3 Implications of these interpretations of Ma1

Taken together, the interpretations described above could span much of Ma1, but teachers appeared to favour particular aspects rather than a balance between several aspects. It was rare for a range of examples to be offered in interview.

Some teachers interviewed for the Mathematics Evaluation Project, having made their own interpretations of Ma1, felt satisfied that they were implementing Ma1, and felt in consequence that much of the mathematics in their classrooms involved Ma1. Other teachers identified the need to make changes in their practice, and were able to describe how they were changing their ways of working.

> *Talking in groups more, over things, and letting them come up with their own ideas and then letting them carry on, and then setting things up which they can ... I would do the tasks and set them at different levels to start it, (now) it's finding tasks that they can work within levels. ...* (Later) *I'm not there but at least I know where I'm supposed to be going.* (Year 2 teacher)

A Year 3 teacher described standing back more:

> *... so I might just ask leading questions of that child, and hope to nudge them on to understanding a bit more.*

For other teachers the requirements of Ma1 did not fit comfortably with their beliefs and caused anxiety and confusion.

> Interviewer: *Yes, and when you're planning, do you actually look at attainment targets one and nine, to put those into your plans?*
>
> Teacher: *Well I look at them, I do look at them and each time I look at them I think ... well I really ought to include these, and I come up against this sort of feeling that ... they don't work.*

(Later) *Well actually I felt that I was doing a lot better before attainment targets one and nine came along, because, I would always try and relate whatever topic was being done, like number work or something, back to a practical outcome, ... like shopping lists were a favourite of mine and, I don't know, paying for things and working how many of so much out and somehow this is lost in attainment targets one and nine. I mean maybe it's just my perception of it but somehow I don't feel that what they've put in there has any particular relevance to real life.* (Year 5 teacher)

If teachers had interpreted Using and Applying Mathematics' in a way which fitted with their current practice, it seemed that little specific planning was thought to be necessary for this attainment target.

Interviewer: *Do you actually put it into your plans at the moment, ATs 1 and 9?*

Teacher: *It's a good question, I have to be honest, I mean, ... I probably don't directly, no ... I think I tend to hope that I cover it on the way.* (Year 5 teacher)

A focus on particular aspects of Ma1 meant that some parts of the attainment target had received more attention than others. When teachers were asked to describe the pupil behaviours which they were trying to encourage, there were indications that teachers were not providing opportunities for all three strands of Ma1 (Applications, Mathematical communication and Reasoning, logic and proof). At Key Stages 1 and 2 teachers were more familiar with providing for the potential to use and apply the techniques, but were not addressing the communications strand nor the strategies of mathematical problem solving and justification. Only one teacher interviewed for the Mathematics Evaluation Project talked about the processes of reasoning, logic and proof, and gave an appropriate example.

Yes, the prime numbers for example ... Some of it wasn't really using Ma1, in that they were given a specific way of doing it, and they had, you know, take multiples of two and colour them in and that sort of thing, so that they were actually directed into what they were doing. But once they'd done that they were given a statement and they had to try and prove whether it was correct or not and they had to draw conclusions from the result. (Year 6 teacher)

Differences in pupils' abilities in Ma1 were often related to personal qualities, particularly confidence. This focus on personal qualities appeared to have led some teachers to be unaware of the need to teach the strategies of 'Using and Applying Mathematics', in any planned or coherent way.

1.6.4 Reading the documents

The translation of educational policy into working documents through the legislative process was discussed by Bowe, Ball & Gold (1992) in terms of 'readerly' and 'writerly' responses (using Roland Barthes' terminology) - the former giving the reader no more of a role than acceptance or rejection of the text, something to be 'delivered' in its entirety. Bowe et al. (1992) describe an initial reading of National Curriculum texts as suggesting such a response. However, the guidance materials (such as non-statutory guidance) suggested a more interpretive response, encouraging more participative, 'writerly' action. The way in which curriculum and guidance materials have been interpreted by teachers and schools will have depended on beliefs and views about curriculum subject areas, and the degree to which they have achieved 'ownership' of the materials. The 'matter taught' remains a step way from the 'matter meant' (Bauersfeld, 1979, p. 204) - the policy makers' intentions. Those involved in mathematics education who were responsible for writing mathematics curriculum and guidance materials should not assume that readings of the texts by teachers will have corresponded with the authors' intentions; a degree of translation inevitably takes place (Knip & van der Vegt, 1991)

The variations in interpretation of Ma1, and consequently in its implementation, revealed by the work of the Mathematics Evaluation Project, indicated the complexity of implementation for many teachers. Yet it not surprising that these interpretations should have arisen. Without a great deal of assistance from their most familiar source of support, the commercial scheme, primary teachers had to rely on their own interpretation of the document in implementing ATs 1 and 9. Even a cursory glance at the PoS and SoAs from the 1989 Order (at the levels appropriate to Key Stage 1) would indicate that teachers' interpretations of Ma1 may well have been limited by the document itself. It may be that the actual wording of the attainment target itself did not present clearly enough the intentions expressed in the non-statutory guidance. A focus on Level 1, for example, of old AT1, would indicate that if children were 'using materials for a practical task' (PoS Level 1), they would be engaged in work which involved 'Using and Applying Mathematics'. This would apply to many activities considered to be a normal part of primary classroom work, and could give rise to the assumption that they were *"cover[ing] it on the way"* (see Section 1.6.3).

Of the nine examples given at Levels 1, 2 and 3 of old AT1 (1989) eight involved measurement in some form. More thought appeared to have been given to the examples in the subsequent document. The examples given in the 1991 mathematics Order differ

in kind from those given in the 1989 version, those in the later document making it plainer that the mathematics should be identified as an integral part of an activity which requires its use for successful completion. 'Use measuring in cooking' (Example, Level 1, 1991) is different in kind from 'compare objects to find which is the longest, tallest, etc.' (Example, Level 1, 1989), which most teachers would describe as part of the teaching of the measurement of length and would always have included in their teaching of this topic.

Askew (1996) drew attention to the title of the attainment target, 'Using and Applying Mathematics', describing it as difficult to reconcile with the focus on logical reasoning: "These explicit references to the purely mathematical and the implications of working with the abstract meant that the title 'Using and Applying Mathematics' became even less appropriate as a means of conveying the spirit of the ATs" (p. 101); and the potential cause of confusion:

> Indeed, the title may be read as something of a tautology. In everyday usage the distinction between using something and applying it is not clear and there is little in the body of the AT which exemplifies this. [...] It seemed that many teachers paid most attention to the title of Ma1, 'Using and Applying Mathematics', assuming the AT to be about real-world applications only. As discussed, the difficulty is that the title does not fully relate to the content of the assessment and teaching schedules, making some teachers feel frustrated or confused and further promoting a sense that Ma1 is unworkable. (p. 111)

It may also have been that the unfamiliarity of the content of ATs 1 and 9 (now Ma1) led some teachers to focus initially on what they saw as the appropriate level for their class, thus establishing little idea of what progression in this attainment target would entail in terms of provision of experiences for pupils. (There were some indications from the Mathematics Evaluation Project that this happened initially in the unfamiliar area of probability, but that this situation was more easily remediable than for Ma1.) In number, for example, few teachers would think in these terms, as their familiarity with this area of mathematics means that they have a progression 'in their heads' and therefore have a longer view of the attainment target, taking into account the different attainment levels of their pupils. In primary classrooms, teachers are creating environments of which numeracy is an integral part, because they are aware of the sorts of activities that will help their pupils to become numerate. The creation of an atmosphere where problem identification and solving is encouraged, where children's own methods are communicated to others and respected by teachers, where the idea of mathematics as consisting of only right or wrong answers is given no credence, may not yet be seen by the majority of teachers as an essential precursor to pupils' development through the strands of Ma1.

The stranding poster that accompanied the 1991 mathematics document presented the progression through each strand more clearly. As teachers become more familiar with the higher levels of this attainment target, it may be that the sort of approach needed to develop children's skills of reasoning, logic and proof, and their ability to communicate their mathematics becomes more explicit, and the development of these skills may become part of the mathematics planned for children at earlier stages in their school life. The change in teaching approach (identified by some teachers as required for the proper implementation of Ma1), may well not have been identified by the majority of teachers, and the additional curriculum guidance materials in which this change in approach was spelled out more clearly (Mathematics Programmes of Study - Inset for Key Stages 1 and 2, and 3 and 4 (NCC, 1991b); Using and Applying Mathematics Books A and B (NCC, 1992)) have not reached all schools.

1.6.5 Summary

The results of the Mathematics Evaluation Project indicated that teachers had made initial interpretations of Ma1, and many of these did not fit with the expectations for this attainment target as set out in the NSG. It has been suggested that this is not surprising considering the nature and title of the Order itself and how it was 'read' by teachers, the limited take-up of the NSG, as revealed by the project, and the limited time which teachers have had to reflect on their interpretations in the light of experience. OFSTED, reporting in 1993 on this part of the mathematics curriculum found a modest growth in emphasis from previous weak development, with the assessment of Ma1 still causing difficulty to teachers in all key stages (OFSTED, 1993a). The results of the Mathematics Evaluation Project pointed to the need to build on and extend the differing interpretations that teachers held of Ma1, to challenge and develop these views.

1.7 The Education Reform Act and the wider context of reform

Alongside the changes implicit in the requirements of a mandatory National Curriculum, the Education Reform Act (Great Britain (Education Reform Act), 1988) included a raft of other reforms. The creation of Grant-Maintained schools and City Colleges, the policy of open enrolment, the devolution of budgets and introduction of formula funding were the result of a policy of reliance on the market solution.

> The market solution represents a paradigm shift in the *economics* of education policy and indeed of social policy generally. It also carries with it a weighty *political* agenda: first, the deconstruction of the principles of collective responsibility embedded, however weakly, in the welfare state after the Second

> World War; second, the replacement of professional control with managerial control; and third, the diminution of the roles and powers of the local state and the concomitant diminution of local democracy. (Gewirtz, Ball & Bowe, 1995, p. 2)

Schools were located firmly in the market place - the intention being that the market should be driven by self-interest. The self-interest of parents would manifest itself in the choice, as consumers, of schools for their children. The self-interest of schools, as producers, would manifest itself in decisions which made sure that their institutions survived the competition from others.

Accountability was stressed - of individual teachers for the implementation of the National Curriculum and its accompanying assessment system (both Statutory Assessment Tasks (SATs) and teacher assessment); of schools for giving good value for money in the educational provision for their pupils. The OFSTED inspection system, set up in later legislation (in 1992), added extra weight to the burden of accountability.

However tightly specified these centrally imposed reforms were, there remained a critical role for schools in mediating policy at local level. Pollard et al. (1994) identified a dimension in responses to educational change that ranged from compliance, through mediation to resistance. Individual differences between schools in terms of their prevailing culture affected where their responses sat on this continuum.

Changes in the pattern and provision of support and Inset from the LEA, together with the delegation to schools of budgets for such activities, made it necessary for schools to look to their internal strengths in developing the curriculum rather than seeking external support. The translation of the National Curriculum into planning and recording documents meaningful to each school resulted in some cases in a greater degree of collective activity, spurred on not only by the professional needs of teachers and schools and beliefs in the efficacy of collective action, but also by the requirements of the inspection system. Decisions had to be made about curriculum organisation in the light of the strong classification (Bernstein, 1975) of subjects within the National Curriculum which might be in conflict with long-established preferences for a more integrated curriculum.

Individual teachers, too, faced conflict about their role, "between their identity as relatively autonomous, creative teachers and their new function as managers of a new curriculum system" (Woods & Jeffrey, 1996, p. 33). 'Intensification' (Apple, 1986, p. 41) was evident not only in increased administrative and managerial responsibilities,

but also in greater complexity of curriculum decision-making and subject knowledge requirements (Askew et al., 1993). Teachers' understanding of their role as one of 'restricted' or 'extended' professionality (Hoyle, 1980, p. 49) impinged not only on their individual responses to these major educational reforms, but also on their readiness to become involved in collective action.

1.8 Conclusion

The context for this research is one of shifting responsibilities for both schools and individual teachers. The top-down imposition of major reform over a time-scale which ignored both the results of previous research and current professional advice created instability and unease. Primary schools faced change across the whole curriculum. No subject area escaped. As this chapter has described, 'Using and Applying Mathematics' represented a major challenge to the existing mathematics curriculum in many schools and its implementation has implications for teacher change and development within a context of wider curriculum and organisational reform in schools. As such it provides an important context for the study of innovation and change. Since the research began there has been additional change in the provision of yet another version of the mathematics National Curriculum (DfE, 1995), produced by Sir Ron Dearing in response to demands for a 'slimmed-down' curriculum (Brown & Johnson, 1996). 'Using and Applying Mathematics' has retained a separate identity and a place of importance in the new curriculum. Its links to the other mathematics attainment targets may have been made more explicit in the new document's more accessible layout. How this document will be 'read' by teachers remains to be seen.

Chapter 2. The theoretical context

> Acknowledging the diversity and complexity of learning milieux is an essential pre-requisite for the serious study of educational innovations. The argument advanced here is that innovatory projects, even for research purposes, cannot sensibly be separated from the learning milieux of which they become part. (Parlett & Hamilton, 1972, p. 90)

2.1 Introduction

Chapter 1 set the context for this research in terms of recent developments in education, with particular reference to innovatory aspects of the mathematics National Curriculum. This chapter focuses on the theoretical context. Perspectives on innovation and change are considered, together with some implications that these perspectives have for choice of methodology.

The theoretical framework adopted for this research is then discussed more fully; however, a degree of selectivity has been utilised. An overview of the literature appropriate to the chosen model is discussed, with attention being drawn to occasions when literature from a variety of relevant domains will be expanded in succeeding chapters to inform the data analysis.

2.2 Perspectives on innovation

House (1979), writing at the end of the 1970s, talked about a "cascade of works on innovation, such that their number and diversity defies cataloguing" (p. 1). He did, however, then proceed to outline three main perspectives from which, he felt, these studies had been generated and interpreted. Miles (1993) in another retrospective account, but over forty years in this case, described strands in his work which related to these three perspectives.

2.2.1 The technological perspective

The technological perspective was committed to a systematic and rationalised approach. It developed not only in educational studies, but also from other areas such as agriculture and industry. The diffusion of innovation in education was investigated by Mort & Vincent (1954), an 'S'-shaped curve being found to represent the rate of diffusion of innovation over time. Katz (1969) compared the diffusion of innovations in studies relating to agriculture and medicine; Webster (1979) in marketing management - "research on diffusion of innovations in industrial markets supports a

conclusion that an S-shaped logistic curve is a reasonably good description of the process over a period of time" (p. 118). Drawing on Rogers' (1962) identified stages in the adoption process (awareness, interest, evaluation, trial and adoption (p. 17)), and his value-laden categories of adopters (ranging from 'innovators' to 'laggards' (p. 19)), Webster (1979) went on to identify some characteristics of early adopters in the industrial field. Havelock (1973) suggested five generalisations about the process of innovation diffusion:

> (1) that the individual user or adopter belongs to a *network of social relations* which largely influences his adoption behaviour; (2) that his *place in the network* (centrality, peripherality, isolation) is a good predictor of his rate of acceptance of new ideas; (3) that *informal personal contact* is a vital part of the influence and adoption process; (4) that *group membership* and *reference group identifications* are major predictors of individual adoption; and (5) that the rate of diffusion through a social system follows a *predictable S-curve pattern* (very slow beginning followed by a period of very rapid diffusion, followed in turn by a long late-adopter or "laggard" period). (Havelock, 1973, p. 159)

There was a supposition, in these studies, that the innovation was something relatively fixed and concrete, making diffusion more susceptible to quantitative analysis. Value judgements linking innovation with progress were clearly made in many cases. However, although these studies focused on the innovation itself, and frequently in a way which regarded the innovation unproblematically, they did draw attention to the characteristics of the adopters of innovation.

Another example of the technological paradigm was the much used (particularly in America) RD&D (Research, Development & Diffusion) model developed and later elaborated on by Guba & Clark (1975). Havelock (1973) described this orientation as being "guided by at least five assumptions": a rational sequence; major planning input; division and co-ordination of labour; a passive but rational consumer, and the suitability of the innovation for mass audience dissemination (p. 161).

House (1979)'s critique of the model was on the basis of just some of these assumptions. Teachers were not passive but were "actively engaged in a local complex-environment with a distinct subculture and set of values" (p.3). House also felt that the approach assumed the creation of easily diffused products that could be transferred to a variety of settings; the unwarranted nature of these assumptions had led to the frequent failure of the RD&D model. Aoki (1984) pointed to the later rejection by Guba of his own model, due to dissatisfaction with the 'unified-system view' and a preference for a 'configurational' view of 'knowledge production and utilisation' (KPU) roughly analogous to the concept of community (Guba & Clark, 1975, p.7/8). "Its [unified-system view] unassailable rational base ... is not the way the world is" (p.9). The idea

of knowledge utilisation required a rejection of the user as "simply engaged in obedient execution of the instructions for a canned product" (Miles, 1993, P. 226). This new conceptualisation has a place in the cultural perspective (see Section 2.2.3).

2.2.2 The political perspective

House (1979) described his own attempt to develop a competing paradigm to the RD&D approach described above, resulting in the political perspective (House, 1974). Innovation problems were interpreted primarily as political ones, "as conflicts and compromises among factional groups, such as developers, teachers, administrators, parents, governments" (House, 1979, p. 4). A focus on the balance of power between central government, local government and teachers (MacDonald and Walker, 1976) led to ideas of curriculum negotiation between developers and teachers and developers and academic critics, with an emphasis on the potential effects of changes in, for example, local government or political events at national level. Becher and McClure (1978) were interested in viewing innovations within broader social change, looking at the political adjustments required.

Although the political perspective suggested that "all was not harmonious" (House, 1979, p. 11), and that conflict was likely, it also assumed that there was "enough value consensus that compromise can be achieved successfully" (p. 11).

2.2.3 The cultural perspective

As its name implies, the cultural perspective moved beyond a study of the innovation itself; beyond a study of those adopting an innovation, to a consideration of the process of change within the cultures in which those charged with implementation were situated. Sarason (1971) drew attention to the need to view change, within a social setting, as a theoretical, rather than a practical problem, involving not "means *and* ends, but a continuous process" (p. 21).

Gross, Giaquinta and Bernstein (1971), through research which pointed to the failure of the technological paradigm to result in innovation in schools, were drawn to a view of educational change as a complex process.

> We concluded that most social scientists have not recognized the need to conceptualize the success or failure of the implementation of organisational innovations as the result of a complex set of inter-related forces that occur over an extended period of time after the innovation has been introduced. Our review indicated that there was a great need for in-depth studies of organizations, such

> as schools, trying to implement oranizational innovations in order to isolate factors that inhibit and facilitate their implementation. Such studies, we contended, were also needed if heuristic models and hypotheses about the implementation of organizational innovations were to be developed. (p. 40)

Ruddock (1977) saw the process of dissemination as an encounter between the shared understandings of the research culture on the one hand and the professional culture on the other - an encounter which involved "communication, interpretation and accommodation" and could lead to "rejection, suspended judgement or acceptance" of an innovation (p. 3), acceptance generally implying adaptation.

A view of change as 'systemic' (Fullan & Miles, 1992, p. 751) involving a focus on all the main components of a system as well as on the culture of the system, necessitated attention at national as well as at local and school levels. Miles (1993) described Fullan's seminal work on innovation and change (Fullan, 1982) as clearly articulating this view of change as being 'of' the system itself, rather than as being change 'within the system' (Miles, 1993, p. 229).

2.2.4 A shift in perspective

House described the change in perspectives on innovation as being "from the innovation, to the innovation-in-context, to the context itself - from the technological to the political to the cultural perspective" (House, 1979, p. 10).

> ... these perspectives can be ordered by one's larger views about society, by whether one sees teaching as a technology or a craft, and by whether on sees educational innovation as involving consensus or conflict. The latter distinction reflects one's basic beliefs about whether social change proceeds in equilibrium or in conflict. (p. 13)

Others have used different names for similar classifications of these three perspectives: Fullan & Pomfret (1977) suggested 'fidelity', 'mutual adaptation' and 'process' (p. 340) as categories of studies of the implementation of innovation.

Along with the espousal of different paradigms went the espousal of different research methods. The technological perspective implied some quantitative measure of adoption of innovation. The political model required the study of competing factional groups within a wider social setting. The preoccupation of the cultural model with symbolic meanings, belief systems, shared values, interactions between individuals, suggested the

use of qualitative methods, frequently within a case study framework. As Parlett & Hamilton (1972) explained:

> The paradigm shift entailed in adopting illuminative evaluation requires more than an exchange of methodologies: it also involves new suppositions, concepts and terminology. (p. 89)

2.2.5 Choice of perspective for the current work

From the point of view of a researcher, all these perspectives have insights to offer. As the recent history of educational change in England and Wales exemplifies, it is necessary for researchers to retain a focus on the intentions of policy makers in initiating change - intentions which may well stem from the uni-directional model of the technological paradigm. The interests of competing groups at different levels of the implementation procedure may well affect how the innovation is received, drawing on the political paradigm.

The failure of many major educational innovations has provoked questioning of the perspectives upon which they were based. The cultural paradigm has been developed both in this country and abroad to something wider than House's (1979) description of a study of the context itself. The model chosen as most appropriate to underpin this work is a framework which, although rooted in the cultural paradigm, nevertheless invites consideration of the meaning (and possible adaptation) of the innovation to those concerned with its implementation (the teachers working in the classrooms) as part of the complex process of change engaged in by individuals within individual organisations.

2.3 The total teacher and the total school

The need to look in greater depth at the total teacher and the total school, rather than simply focusing on the relationship between teacher development and the implementation of innovation, has been identified by Fullan & Hargreaves (1992a) and a model containing four main elements for investigation proposed (p. 5).

- The teacher's purpose
- The teacher as a person
- The real world context in which teachers work
- The culture of teaching: the working relationship that teachers have with their colleagues inside and outside the school.

2.3.1 The teacher's purpose

2.3.1.1 General theoretical perspective

The first of the model's elements relates to the beliefs and values held by teachers and their implementation in the classroom. Change is multidimensional, with innovations in materials, teaching approaches and teachers' beliefs all being involved in the implementation of any new initiative (Fullan, 1991). Changes in practice must generally be preceded or accompanied by changes in beliefs if the implementation of innovation is to be successful and lasting (Fullan, op cit.); the level of beliefs and values, according to Nias, Southworth & Yeomans (1989), being the "deepest and most difficult to reach" (p. 16).

However, the teacher's role is traditionally an isolated one (Lortie, 1975), making the examination and questioning of beliefs difficult. Evaluation of self and colleagues tends to rest on external indicators of classroom practice such as order, noise level and results. This individualised focus leads teachers to use their classroom experiences as the basis for discussions on curriculum change; a wider basis for discussion is sometimes not encouraged by those in positions of authority within a school (Hargreaves, 1989). The resulting individualistic culture can breed

> · norms of reticence and isolationism. When teachers are reticent to provide feedback to one another and prefer to act as 'gatekeepers' to their isolated 'kingdoms' rather than as professional colleagues, the prospects for positive educational change are reduced" (Grimmett & Crehan, 1992, p. 62).

Change involves risk-taking and insecurity for all those concerned: one of the participants in Wideen's study of school-based teacher development commented, *"[b]ut when someone has dealt with a programme for a long time and has ownership, it's really hard ... to leave the security of their programmes that were running very well"* (Wideen, 1992, p. 143). Even when underpinning beliefs are already in place, confidence in implementing change may be tempered by contextual factors, such as the opinions of colleagues or parents (Nolder, 1992a).

How individual teachers respond to an innovation will depend in part on characteristics specific to the innovation itself. A lack of conviction of the need for a proposed change was one of the four characteristics identified by Fullan (1991) as being of importance in its implementation (need, clarity, complexity and quality or practicality). Gross, Giaquinta & Bernstein (1971) found that lack of clarity about an innovation could militate against its implementation.

2.3.2.1 The special case of mathematics

Knowledge of mathematics and beliefs held by teachers about mathematics and its teaching have been extensively researched (eg. Thompson, 1984; Clark & Peterson, 1986; Oprea & Stonewater, 1987) and a range of positions identified from which teachers view mathematics (Lerman, 1986; Ernest, 1989). This has frequently been in the domain of secondary teaching, amongst those choosing to specialise in the teaching of mathematics. Research among generalist primary teachers is less common, much of it emanating from the USA. The beliefs of pre-service teachers about the teaching of mathematics have been investigated (Civil, 1993), as have issues relating to changes in mathematics practice through intervention of one kind or another (eg. Carpenter, Fenema, Peterson, Chiang & Loef, 1989; Wood, Cobb & Yackel, 1991).

Reviews of studies of teachers' beliefs (eg. Hoyles, 1992; Thompson, 1992) have drawn attention to the complexity of the relationship between beliefs and practice. Translation of beliefs into classroom teaching is mediated through the many facets of context and culture, resulting sometimes in practice which barely, if at all, reflects stated intentions (Desforges & Cockburn, 1987). Changes in beliefs are similarly mediated. The literature on teachers' beliefs about mathematics and its teaching is developed more fully in the analysis of views of individual teachers described in Chapter 7.

Beliefs about those aspects of mathematics known as 'Using and Applying Mathematics' (Ma1) have been shown to vary widely (Johnson & Millett, 1996). Askew (1996) identified a variety of ways in which some teachers had interpreted Ma1 in order that it fitted with their current belief systems and caused minimum disruption to existing practice. The same study (Askew et al., 1993), revealed that those teachers who had recognised the complexity of implementing 'Using and Applying Mathematics' reported challenges to, and changes in, their beliefs, whether approaching Ma1 as 'bolt-on' or 'built-in' to the curriculum.

The research literature on problem-solving or investigative approaches to mathematics has been equivocal in its views on the actual teachability of problem-solving (Lester, 1982), and also on the advice to teachers on developing their own teaching in this area. For example, Stanic & Kilpatrick (1989) described Polya's view of problem solving as an art, with the teacher playing a key role by selecting the right kinds of problems, and providing the guidance when needed. On the other hand, Lave, Smith & Butler (1989) suggested an apprenticeship model for children's introduction to problem solving and discussed such critical skills as problem finding, the application of skills learnt in other contexts and the exploitation of the properties of the existing situation.

Within the context of the development of mathematical thinking, with its essential component of reflection (Mason, Burton & Stacey, 1982), the recognition of practice which would encompass the aims of Ma1 requires the close examination of many of the popularly held tenets of what constitutes good primary mathematics practice. A match between views appropriate to the permeation of Ma1 through the mathematics curriculum, and teachers' views of what constitutes 'school mathematics' (Gregg, 1995, p. 443) is also problematic. A discussion of the innovation of 'Using and Applying Mathematics', with its focus on a problem-solving and investigative approach, is developed through more extensive reference to the literature in Chapter 9.

2.3.2 The teacher as a person

2.3.2.1 General theoretical perspective

The second element in Fullan & Hargreaves' model (1992a) recognises that the motivation of teachers in responding to innovation, or continuing with innovative practices once started, will not only be affected by their beliefs and values (purpose) but also by personal factors - aspects which Fullan & Hargreaves felt had been "neglected in teacher development" (p. 5).

Responses to innovation may well be affected by the stage of career which individual teachers have reached. Huberman (1992) reviewed the research in this area, identifying several trends which recurred across studies, enabling him to categorise certain phases which were likely to occur during a professional life-cycle. Age is also likely to play a part in affecting responses to change (Sikes, 1992; Pollard et al., 1994), as are critical incidents in both personal lives (Sikes, Measor & Woods, 1985) and those emanating from the external context (Ball & Goodson, 1985). These literature references are extended in context in Chapter 7.

2.3.2.2 The special case of mathematics

In terms of teachers' responses to developments in mathematics, consideration must also be given to teachers' own mathematical histories, their qualifications in, and confidence about teaching, mathematics. A minority of primary teachers possess qualifications in mathematics at A level or above (Askew et al., 1993). Many lack confidence in their own competence (OFSTED, 1994); confidence for some Key Stage 1 teachers has declined since the introduction of the National Curriculum (Bennett et al., 1992). In some cases, the questioning of competence may be realistic (Carré & Ernest, 1993) with implications for action needed to supplement and develop teachers' subject knowledge

(MacNamara, 1995), particularly at a time of decline in the provision of advisory support. Factors relating to the understanding of, and confidence in, mathematics are discussed further in Chapters 6, 7 and 9, in relation to responses to the innovation of Ma1.

2.3.3 The school context and culture

2.3.3.1 General theoretical perspective

Although the primary focus in this work has been on the individual teacher, it has been considered important to address aspects in the model of both context and culture (See also Chapters 4 and 5). Fullan & Hargreaves' third and fourth categories of work context and the culture of teaching, explore the teacher's place within the whole school and wider social situation. The importance of the classroom context has already been mentioned, but the work context of teaches must also encompass school type and locality and the social contexts in which learning and teaching take place. Schools have had varying degrees of success in building up involving and positive relationships with parents, pupils and the local community (Hopkins, Ainscow & West, 1994). In turn, parental expectations will have an effect on the willingness and ability of teachers and schools to change or adapt established practices (Fullan, 1988). The ways in which schools reconcile what they consider to be of 'merit' with teachers perceptions of parents' judgements of 'worth' (Guba & Lincoln, 1985, pp. 39/40) will help to determine the future of an innovation.

Fullan & Miles (1992) described change as "resource-hungry" (p. 750). Variations in support and finance according to school status and locality (more evident since the Education Reform Act, 1988), will also affect how an innovation is resourced in terms of materials, training and time. OFSTED (1996a) found figures on the adequacy of resources "disturbing" (p. 11); while calling for these to be acted upon, OFSTED chose also to focus on why it was that inadequacies affected teaching in some schools and not in others.

Attention has been drawn to the nature of the school as a social organism (Waller, 1932; Sarason, 1971), and to the need for a study of its culture to include the shared beliefs, values and norms considered to be of importance by its members (Stenhouse, 1983; Deal, 1985; Grimmett & Crehan, 1992). Some schools have been shown to be more effective than others in creating a positive learning environment for both children and teachers, which can facilitate whole-school approaches to curriculum planning (Sammons, Hillman & Mortimore, 1995). Such factors as purposeful leadership by the

head (see also Ball, 1987; Southworth, 1987; Reynolds, 1994); involvement of teachers in planning and development; consistency among teachers and an emphasis upon a shared belief system and collaboration appeared to contribute towards the development of such an environment (but how this knowledge could be transferred to improve schools identified as in need of improvement is less clear (Brown, Duffield & Riddell, 1995)).

For the close, almost symbiotic relationship between teacher development and whole-school development to result in fruitful implementation of innovation, both individual and collective learning activities are required (Nias, Southworth & Campbell, 1992). A shared belief in the importance of teacher learning involves the acceptance of the possibility of improvement and a readiness to be self-critical and to recognise better practice Not only can teacher professionality contribute to the creativity of a school, but also the chosen ways of working of the school itself can stimulate and encourage professional development in teachers. The 'extended' (as opposed to the 'restricted') professional (Hoyle, 1980, p.49) is able to both evaluate her own work through reflection (Schon, 1987; Louden, 1991) and compare it with that of other teachers in a collaborative atmosphere that focuses on an educational context broader than the individual classroom. At a whole school level, 'extended' rather than 'bounded' collaboration (Fullan & Hargreaves, 1992b. pp. 74/5) is more likely to address curriculum development issues in depth. However, a collaborative culture exhibiting collegiality through shared beliefs about values and ways of working (Campbell & Southworth, 1992) should, according to Hargreaves (1992a) be distinguished from contrived collegiality where collaboration has become a mandatory rather than voluntary activity.

Although a shared vision of the change process may exist, this is not necessarily sufficient if the mechanisms for change are not also addressed. Gross et al. (1971) cautioned against simplistic attribution of failure of innovation to resistance by teachers (although resistance is one of several possible responses (Pollard et al., 1994)), when provision for the development of the subject knowledge and pedagogical skills needed by the teachers, the necessary materials, and the organisational arrangements compatible with the innovation had not been made. The way in which a school is managed (Gray, 1982; Davies & Morgan, 1983; Bush, 1986), which can both reflect and affect aspects of its culture, will determine how these strategies for the provision of both pressure and support (Fullan, 1992) are decided upon and set in motion.

> Successful change projects always include elements of both pressure and support. Pressure without support leads to resistance and alienation; support without pressure leads to drift or waste of resources. (Fullan, 1992, p. 128)

Hopkins, Ainscow & West (1994), drawing on Miles (1986), described the process of change as consisting of three overlapping phases - initiation, implementation and institutionalisation, the last of these being "the phase when innovation and change stop becoming something new and become part of the school's usual way of doing things" (p. 38). In the course of this, the innovation may itself have become adapted (Fullan, 1988). Different qualities, both individual and collective, may well be needed for this phase of the change process. The timescale for change to be effective should not be underestimated. Fullan (1988) pointed out the need to "recognize implementation as a process which takes some time, and which requires a monitoring or information system during the implementation period ... " (p. 202); it was unreasonable to expect significant change to be effected in less than two or three years. Huberman & Miles (1984) concluded from their research:

> Strong institutionalisation seemed to require some administrative pressure, lack of serious local resistance, and at least minimal teacher-administrator harmony. It also thrived on staff and leadership stability, organisational transformations that rooted the new practice in local structures and procedures, and levels of assistance adequate to bring about stabilized use by a large percentage of the eligible users. (p. 277)

2.3.3.2 The special case of mathematics

The starting point for a whole-school framework for developing approaches to 'Using and Applying Mathematics' that permeate the mathematics curriculum (the initiation of the process of change) might well be self-analysis by teachers of their own strategies of management, teaching style and beliefs about mathematics. As has been discussed in the previous section, the ability of a school to create an atmosphere that fosters and supports this kind of self-evaluation and reflection may determine whether this starting point is ever left.

Some members of the school's teaching population may be identified as 'change agents' (Havelock, 1973), people who "facilitate[s] planned change or planned innovation" (p. 5). The degree of success of those working to effect change within the school, such as, for example, the mathematics co-ordinator, will depend to a large extent upon an appropriate definition of their role (Osborn & Black, 1994); upon the match between expectations and resources (Campbell, 1985) and upon the structures established in the school through which they carry out those roles. But it must also be remembered that teachers are themselves "in the rather strange position of being simultaneously both the

subject and the agent of change" (Sikes, 1992, p. 36) and may experience tensions associated with the duality of this position. Chapter 6 develops the literature on the role of the co-ordinator in greater depth.

2.4 Summary

For this study, research emanating from the cultural perspective was deemed to have the most to offer in providing both a theoretical context and significant pointers to inform data collection and analysis, thereby increasing understanding of how to investigate the change process. However, other perspectives should not be ignored; a sufficient focus must be maintained on the innovation itself, and on the characteristics of those who are required to implement it. The perspective from which the innovation emanates, the policy maker's perspective, must also be considered; this perspective, whether overtly stated or not, will affect not only how the innovation is received, but also what expectations the policy maker has of 'effective' implementation and how it is to be 'measured'.

Key contributors to the theoretical underpinning of this work may be identified: Fullan, (1991), Fullan & Hargreaves (1992a, 1992b) and Hargreaves & Fullan (1992) in providing an extremely comprehensive discussion of the implementation of innovation; Nias, Southworth & Yeomans (1989), Nias, Southworth & Campbell (1992), Bush (1986), Campbell (1985) in identifying and developing issues to do with the whole school and those working within established roles; Hoyles (1992) and Thompson (1992) in focusing attention on the complexity of the relationship between individual teachers' beliefs, practice and changing practice in mathematics teaching, and Askew (1996) for illumination in the area of 'Using and Applying Mathematics' itself.

2.5 Conclusion

In this chapter, the background to the theoretical model adopted to inform this research has been developed, and different parts of the model explored. The breadth and scope across the four elements has been outlined in this chapter, but, as indicated, the literature will be returned to and extended as appropriate in further chapters when analyses arising from the research are discussed. Chapter 3, which follows, relates the theoretical context to the research design and methodology selected for this study.

Chapter 3. The research - aims, methodology and research design

3.1 Introduction

Chapter 1 placed this research in the context of developments in mathematics education in recent years. Chapter 2 described its location in terms of theoretical underpinning.

In this chapter, the aims and objectives of the present research study are spelled out. The research questions to be addressed are posed. The methodological considerations which drove the selection of research design and methods of data collection and analysis are discussed, together with the translation of decisions about data collection into phases of the research.

3.2 Aims and objectives of the research

The overall aim of the study is to explore those factors, both school-specific and teacher-specific, that facilitate and support, or inhibit and delay, the permeation of 'Using and Applying Mathematics' through a school's mathematics curriculum. Within this overall aim a number of research questions arise:

1. What are the changes required of and experienced by teachers in the implementation of the National Curriculum, with particular reference to any pedagogical procedures arising from the innovation of 'Using and Applying Mathematics' (Ma1)?
2. How do primary teachers' interpretations and implementation of 'Using and Applying Mathematics' evolve, and what is the dialectic between interpretation and practice?
3. What is the relationship between policy developments, classroom practice and the theoretical background to using and applying mathematics?
4. What are the tensions between teachers' individual beliefs about, and subject knowledge of, mathematics and the development of a shared culture; how, if at all, are these tensions resolved or reconciled?
5. What is the relationship between teachers' needs in terms of professional development and school needs in terms of coherence and curriculum change?
6. Which aspects of organisational practices, channels of communication and leadership roles facilitate or inhibit whole school innovation and change?

The objectives of the research are to focus on selected aspects of these questions, with particular attention being given to questions 2., 4., and 6.: to investigate the evolution of

teachers' beliefs about mathematics and the interplay between beliefs and practice in the implementation of Ma1; to place the teacher within the wider context of the whole school and to explore any tensions which may exist between individual and collective priorities; to study the role of the school in facilitating or inhibiting whole school innovation and change. In addressing these objectives it is hoped to come to a greater understanding of the process of change within the primary school setting, taking the innovation of 'Using and Applying Mathematics' as the context for exploration.

This research draws on general theories of change (discussed in Chapter 2), tests their applicability to the particular and extends them through the study of the radically innovative pedagogy (in terms of most teachers' current practice) that is implied by the implementation of Ma1.

3.3 Methodology

3.3.1 The choice of qualitative methods

In discussing the meaning of change, Fullan (1991) emphasised the need to consider both the subjective meaning of change for individuals, and the objective meaning of change. The multidimensional nature of change in practice, involving the "the possible use of new or revised materials, the possible use of new teaching approaches, and the possible alteration of beliefs" (Fullan, 1991, p.37) involves a complexity which is not conducive to the use of quantitative tools. Superficial measures of, for example, the take-up of new materials by schools may tell us little about the actual use of those materials in the classroom, as curriculum developers have found to their cost. Research into teachers' beliefs and the translation of these into practice (eg. Thompson, 1992, Hoyles, 1992) has highlighted the complexity of this process and the need for the 'situated' nature of beliefs (Hoyles, 1992, p.40) to be considered. These are issues which require in-depth study and cannot fruitfully be the subject of short-term approaches.

My own experience of teaching and management in primary schools had led to the conviction that only by attempting to understand the complexity, can useful insights be obtained about the processes involved in innovation and change, and that this understanding can only be achieved through the use of qualitative methods. The use of such methods in fieldwork implies the taking by the researcher of a stance of inquiry, a "search for meaning, a suspense of preconceptions, and an orientation to discovery" (Ball, 1990, p. 157), rather than any attempt to fit interpretations into a pre-ordained

theoretical framework. Describing a grounded theory, developed first by Glaser and Strauss (1967) as "one that is inductively derived from the study of the phenomenon itself", Strauss and Corbin (1990, p. 27) pointed to the reciprocal relationship between data collection, analysis and theory. In later writing Strauss & Corbin (1994) warned against a partial application of the methodology where users fail to conceptualise adequately and are thus unlikely to produce "conceptually rich theory" (p. 277).

Theory has been influential in both the planning and conduct of this research. In making me sensitive to the breadth of the field over which data should be collected, a consideration of 'the total teacher and the total school' (Fullan & Hargreaves, 1992a, p.5) provided the broad sweep of participants, beliefs, experiences, roles, feelings and events which was then explored through theoretical sampling (Glaser & Strauss, 1967):

> [T]he process of data collection for generating theory whereby the analyst jointly collects, codes and analyses his data and decides what data to collect next and where to find them in order to develop his theory as it emerges. This process of data collection is controlled by the emerging theory, whether substantive or formal. (p. 45)

3.3.2 The need for rigour

Within qualitative research there is a continuum of research paradigms which guides the design of an investigation (Denzin & Lincoln, 1994, p. 200). Attempts to ensure rigour in the research process are made or decried depending on the positions of researcher and critic on this continuum. I have attempted in this research, to strive for that degree of rigour which follows from keeping self-awareness and self-criticism at the forefront of the researcher's role, although I fully accept Louden (1991)'s stricture that "the rigour of the research method cannot guarantee the truth of the research conclusion" (p. xv). Ball (1990) encouraged a process of 'reflexivity' (p. 159) which made technical rigour possible through the linking of the technical processes of data collection with the social process of engagement in the field. Whilst not making claims to having arrived at any objective 'truth' (see also Hammersley, 1990) through these attempts, I feel that it is nevertheless reasonable to use methods of triangulation and respondent validation as appropriate to explore the distance between researcher's and participants views of the world.

3.3.2.1 Triangulation

Bloor (1978) raised some issues about the value of triangulation:

> Given the assumption that there is always one best method for tackling a particular research problem, what is the point of trying to reproduce one's findings by use of additional, inferior data generated by additional, inappropriate methods? (p. 548)

Not sharing Bloor's conviction that there is necessarily 'one best method', or that data collected by additional methods should be regarded as 'inferior', rather than complementary, I prefer Denzin & Lincoln (1994)'s description of the use of multimethods, or triangulation, as "a strategy that adds rigor, breadth, and depth to any investigation" (p. 2). In accepting the use of triangulation as just such a strategy, I have in this research employed methodological triangulation (Cohen & Manion, 1985) in which a variety of methods of data collection have been used (eg. interview, observation, study of documents) to provide a basis for comparison, one with another, during the course of the research. I have also compared reports of beliefs or events over time (time triangulation), at different levels of analysis (individual, group and organisation), and in different settings.

3.3.2.2 Respondent validation

The respondent validation which I employed in this research was mainly, though not entirely, on an individual basis. The purpose of this validation was to establish the degree of correspondence between the views of respondents in the research setting and my own interpretations and analyses as the observer, and to do this "by exploring the extent to which members recognize, give assent to, the judgements of the sociologist" (Bloor, 1978, p. 548)

In some cases, the validation was factual verification (in transcripts of interviews); in others interpretations and analyses were included in the accounts returned (lesson observations, vignettes of key informants). Ball (1984) commented on the lack of interest from respondents in his work. I, too, noted a paucity of comment (with one or two exceptions), but was loath to attribute it to lack of interest; I felt rather that it exemplified the pressured conditions under which these teachers were working.

Towards the end of the fieldwork, a report was prepared for the school which summarised the conduct of the research, the data collection and analysis, and ventured some early conclusions. This was made available to all the teachers who had participated in the research. It was commented on as a source of interest, but produced no strong reactions of a positive or negative kind. By the same token, it did not provide me with much feedback on the correspondence between researcher and respondent.

3.3.3 Methods of data collection

This research took the form of a case study. Case study is not a methodological choice, it is the choice of an object to be studied (Stake, 1994). Data was collected through the use of a variety of methods - interview, observation and the study of school documents. The work in school was designed to address the research questions through the sampling of experiences/views, settings and events. Initial interviews with all teachers, including the Headteacher and maths co-ordinator, and data collected in fieldnotes were designed to lead, through an initial stage of 'open sampling' (Strauss and Corbin, 1990) to the identification (through judgement sampling, Johnson, 1990) of key informants, to ensure that a range of experiences/views were represented in the later phases of work in school. Accepting the symbolic interactionist stance that different settings affect social action, sampling of settings included the classroom, the staffroom and a variety of more formal meetings. Sampling of events fell into two broad categories: first, classroom observations of mathematics teaching to build up a picture of the culture of teaching within the school as well as provide insight into individual changes; second, observation of events spanning the range of collective activities engaged in (and recorded in fieldnotes) in order to chart the development of the school mathematics culture. Such events included mathematics Inset activities, mathematics curriculum meetings and informal gatherings and discussions. Final interviews with teachers were designed to elicit experiences of, and views about, any changes identified over time and the process of change itself. These methods are described in greater detail in Sections 3.5.2, 3.5.3 and 3.5.4.

3.3.4 The role of the researcher

The nature of the research design, involving the use of qualitative methods of data collection, required me to take on the role of participant observer. The precise role of the researcher involved in participant observation varies according to the nature of both the researcher and the research. Bell (1969) described 'participant observation' as varying "from total participation with no observation to observation with no participation" (p.417). Some researchers in educational settings participate in teaching (Ball, 1981), others do not. Louden (1991) began his research as a non-teaching participant, but changed "from peripheral participant observer to equal collaborator in teaching" (Louden, 1991, p. 70). King (1984) described his role as something close to observation with no participation.

My intention, stated clearly to all the staff at the beginning of the research, was to be in the school as someone known to be a qualified teacher, but whose purpose was to discover the beliefs and practice of the teachers in the school, rather than to assume an 'expert' role involved in disseminating practice to teachers. I did not therefore participate directly in teaching, but my contacts with teachers were ostensibly as a qualified teacher with some expertise in mathematics education and school management. Ball (1990) noted that a search for credibility with one group of members of a setting could lead to a lack of credibility with another group. He described ethnographers as seeking "to be all things to all people" (p. 166). I became more aware of such problems as the research progressed, as the way in which I was regarded and regarded myself came to be based on increased knowledge and personal feelings on both sides.

Defining my role, perhaps, as a peripheral participant observer, I nevertheless frequently felt like Delamont (1984):

> Overall I do not think what I did can usefully be called participant observation, because I did not participate in any meaningful way. Instead I 'lurked' and watched. (p.27)

The participant observer's function is not to remain on the outside of the research culture, but entails a commitment to "become embedded in the perspectives of those who inhabit the socio-cultural world that is to be described and analysed" (Ball, 1984, p. 72). A necessary concomitant of this, which must be carefully documented by the researcher, is the undoubted impact that the researcher has on the research setting, and the selectivity she will employ in gathering data, since all our understandings are constructed through the preconceptions we bring to situations. Hammersley (1984) stressed the need to reflect on these influences, saying that "... the function of a reflexive account is to indicate the nature and likelihood of such threats ..." (Hammersley, 1984, p. 41). In order to facilitate the documentation of the effects of my presence on the research, I developed a coding category for both fieldnotes and interviews which reflected instances either of where the teachers had referred specifically to some impact of my presence that they had recognised, or of where I had interpreted responses or comments to imply some effect of my role in the school.

The difficulties I experienced in carrying out my role in the school came from some expected, and some unexpected, quarters. I had anticipated the need to be particularly sensitive as regards my identification as a 'mathematics expert' with the majority of teachers, but on the whole their anticipated anxiety was a problem in my eyes rather

than theirs - except, that is, for the mathematics co-ordinator. Although she had a strong mathematics background, she was not personally a confident person and entertained many reservations about the way in which she performed her role (see Chapter 6). The open raising and discussion of this problem was successful in ameliorating it to some extent.

I had not expected time constraints to be quite so difficult. There was no problem with time-tabled meetings, interviews and observations. It was catching teachers for just a few minutes at a time which proved to be the greatest impediment to data collection. The 'lurking' element of the role, described by Delamont (see above), sometimes became too much to bear, and I would go home without having been able to face imposing on a teacher yet again, and thus perhaps have missed making a time which might have been mutually convenient.

3.3.5 The protection of participants

Delamont (1984) stressed the importance of protective pseudonyms for participants and I totally share her views on this subject. I chose a method for selection of names which made it comparatively easy for me to relate one to the other; I used them in the earliest stage in the research and consistently from then onwards. I found, as she did, that the pseudonyms became more lasting than the real names. "It soon becomes easier to remember that Tessa and Zoe are friends than that A and B are. Indeed it is harder today to recall the real names of my sample than the pseudonyms" (p. 31). I tried to make it clear to participants, however, that although pseudonyms gave protection from identification by those outside the school, it was not possible to entirely protect many of those within it, as they were identifiable by their roles and responsibilities.

I was particularly aware of the need for confidentiality to be preserved. Interviews were confidential, but views and personal circumstances aired at meetings were, so to speak, in the public domain. I found it important to distinguish constantly between my sources of data in this way, and remain watchful of any slippage between the two.

3.3.6 Generalising from case study research

Doubts about the possibility or advisability of generalising from case studies have been frequently raised. Walker (1993) passed the problem of generalising from the author to the reader. It was the reader, he suggested, who should be asking what, in a particular study, applied to her own situation. Stenhouse et al. (1982) felt than in case study, general laws were not offered, but experiences were portrayed that could be applied to new situations. Miles (1993) asserted that every school was unique, but "every school is also like *some* other schools in some respects and like *all* other schools in some respects" (p. 214/5).

Stake (1994) was of the opinion that too great an interest in obtaining generalisation detracted from an adequate focus on the interest of the case study itself. He warned against the damage that occurred "when the commitment to generalize or create theory runs so strong that the researcher's attention is drawn away from features important for understanding the case itself" (p. 238). Others, however, have cautioned from a different stance. Delamont felt that it was necessary to develop studies into more general frameworks if they were not to be "doomed to remain isolated 'one-off' affairs" (Delamont, 1990, p. 141).

I feel drawn rather to Stake's commitment to the values of case-study with its focus on uniqueness and diversity. He described 'naturalistic generalisations' (Stake, 1980, p. 69) which develop within a person as a result of experience.

> They seldom take the form of predictions but lead regularly to expectation. [...] These generalizations may become verbalised, passing of course from tacit knowledge to propositional; but they have not yet passed the empirical and logical tests that characterize formal (scholarly, scientific) generalizations. (p. 69)

Simons (1994), too, was concerned to draw attention to the value of "understandings generated from the single case" (Simons, 1994, p.3), particularly at a time when policy makers were searching for similarity, certainty and generalistion, and were thus drawn to more objectivist forms of evaluation. She described the 'paradox of case study' as follows:

> ... case study celebrates the particular, the unique, and frequently yields outcomes that are inconclusive. The paradox is that therein lies its strength for policy-making but this is often seen by policy-makers to be its weakness. (p. 3)

This focus on understandings from the particular does not preclude the communication of those understandings; indeed a commitment to the value of the understandings must

result in clearer communication, "in order for others to create meaning from the educational encounters we describe and interpret" (p. 12).

3.4 Research design

3.4.1 Initial intentions

It was proposed initially that the setting for the research would be two primary schools selected through evidence of a commitment towards mathematics as a priority area in their development plan (identified with the help of LEA mathematics advisers and inspectors), with both mathematics co-ordinator and headteacher committed to a particular focus on the development of using and applying mathematics across the mathematics curriculum. Social and geographical factors which affected the schools would be investigated, as far as this were possible. (This design was later amended, for reasons described in Section 3.4.4)

The processes of curriculum planning and implementation would be studied over a period which included two school years. Primary schools' development plans are usually structured around the school year with any particular subject given priority for one year at a time. Recognising that the development would not begin and end with the year, time leading up to the focus as well as changes and developments subsequently were also considered important. It was anticipated that one school would be studied in year one, with a further school being added on the basis of its mathematics focus beginning in the Autumn of the following year. The lead up to the mathematics focus in the second school would be studied during the summer term before the focus began and in the Autumn term after the focus has finished. The first school would also continue to be studied for at least one term after its focus had finished. The overlapping nature of the design and the fact that data collection and analysis would run concurrently permitted a degree of longitudinal study. However, in recognition of the fact that effective change may take up to three years (Fullan, 1991), I intended that the research design should remain flexible enough to take account of ongoing developments in the school(s) selected or changes in direction not anticipated at the beginning of the research. This flexibility could be preserved by reserving the selection of the second school until the course of development in the first had been to some extent established. Local financial management of schools might also have affected the time span covered by school development plans, with some aspects of these plans being adjusted to coincide with the financial year.

3.4.2 The selection process

The background to this research pointed to the need to select schools in which there was maximum potential for change. Pollard et al (1994) noted, in agreement with Bowe, Ball & Gold (1992), that some schools were in a better position than others to respond creatively to change and suggested that the fostering of a collaborative culture helped them to adapt. The following criteria were drawn up to reflect the needs of the research, both in terms of the potential mathematical development, with particular reference to Ma1, within the whole-school culture, and in terms of the provision of an atmosphere conducive to my presence as a researcher.

1. The school should have decided upon mathematics as an area of focus. This was necessary to provide a sufficient concentration of the school's curriculum development time to maximise the possibility of change taking place.
2. The decision to develop the mathematics should include a commitment to implementing Ma1. This was included to indicate how far 'along the road' the school was in terms of Ma1. If the need to develop Ma1 had been identified by the school, it was felt that considerable thinking might already gone into Ma1.
3. Both Headteacher and mathematics co-ordinator should be firmly committed to the development. The importance of the Headteacher in facilitating change was acknowledged by the use of this criterion.
4. The mathematics co-ordinator should have some strengths in mathematics - eg qualification in mathematics at least at 'A' level or above; attendance on a 20 day course, Diploma or Masters degree. This criterion was established partly in recognition of the fact that the presence of a researcher could undermine the confidence of mathematics co-ordinators who might feel that their mathematical knowledge was lacking or that their philosophy related to pedagogy and practice lacked coherence. It was also in recognition of the greater strength likely to attach to the leading role the co-ordinator must of necessity play in the process of mathematics development.

These four criteria were initially considered to be the main essential criteria, and it was on the basis of these, together with an outline of the aims of the research, that mathematics advisers or inspectors in six Local Education Authorities were approached.

The advisers provided varying numbers of schools to visit, all of which had been told about the aims of the research, and all of which were presumably felt to provide interesting environments for mathematical development. Initial contacts were made with some or all of these schools by telephone, and following discussions with the

Headteachers, it was decided whether or not a visit would be appropriate. In some cases it was decided mutually that circumstances were not favourable for involvement in the research. The factor most frequently involved here was that the postholders were new in the post and needed time to establish themselves in their roles.

Five schools were visited (notes on these visits are given in Appendix 1); on these visits, information regarding an additional eight criteria was sought, as well as impressions of relationships within the school, style of management, attitude to visitors and background information about the school.

5. The staff should have been involved in the decision to take part in the research.
6. The staff should have been consulted over the decision to develop the mathematics, and should have been in favour, ie seen the need.
7. The development of the mathematics should include the decision to write or re-write the school scheme of work for mathematics.
8. The school should have at least eight members of staff
9. There should be some history of collaborative curriculum development
10. The school should be reasonably well resourced for mathematics
11. The staff should be interested in the research
12. There should not be a history of heavy reliance on a scheme.

Four out of the seven schools visited fulfilled the first four criteria. Apart from these four essential criteria, it was anticipated that a very flexible approach would be taken to the additional criteria, with the possibility that other criteria might arise from the visits. What emerged from these visits was that Criterion 5 seemed to assume the status of an essential criterion. The importance placed by the Head on the proper consultation of her/his staff, ie full consultation as to whether they would be in favour of having the research going on in their school, gave some indications about the extent of collaboration in the school. In one school, Castle Street, there was no suggestion that staff should be consulted, and both Head and mathematics co-ordinator seemed prepared to give the go-ahead to the research without this important step being taken. Queen's Road primary consulted the staff themselves. Sands primary and Greenside primary asked me to attend a staff meeting and address any worries that staff might have directly.

It seemed to me on reflection that this concern for the feelings and wishes of staff should be considered an essential part of the selection process, and the choice had therefore to be made between these two. It should be mentioned here that choice did not lie solely with me. The two groups of staff involved, together with Heads and co-ordinators were also making decisions about the advantages to the school of being

involved in the research process, the likely effects, both positive and negative, of having this particular researcher in the school, and at the end of a long and difficult term, these decisions were affected by a desire to limit any extra effort they might have to make, if it was not necessary.

Greenside primary school had an exceptionally welcoming and friendly atmosphere, and it was assumed that I would want to see round the school. Head and co-ordinator were not prepared to go ahead with accepting the research without the full backing of the staff, even though the Head was in favour, feeling that there would be substantial benefits to the school in terms of encouraging a greater degree of reflection about mathematics. Another advantage of this school was that teaching styles apparently varied throughout the school, as did reliance on a commercial scheme, thus providing interesting variety in pupils' classroom experiences. One disadvantage, however, was the size of the school. A staff of 17 might make data collection and analysis unwieldy. However, this disadvantage was outweighed by the other qualities the school possessed. The atmosphere at the staff meeting which I attended was relaxed and each member of staff greeted me as they came in. They asked questions which revealed anxieties mainly about my status as an observer (as opposed to a 'maths expert'), and about the demands on their time. These latter anxieties were somewhat assuaged by the commitment of the Head to allowing interviews to be conducted in non-contact time. The final selection was therefore in the hands of the staff of Greenside school, and I felt very positive about the fact that they decided that they would like the research to go ahead. A vignette of Greenside School and an outline of its plan for the mathematics development in the school are given in Chapter 4.

3.4.3 Two comparative schools

Initial contacts with two schools in the selection procedure had revealed that mathematics had already received a position of priority in the school, and the year from September 1993 would be one of consolidation, rather than new development. In the case of both these schools (Fellside and St Mary's schools) it was decided to visit, and write up briefly the development so far, and keep in touch with the schools over the year of consolidation. The purpose of these contacts was to establish a second set of schools to provide useful information for me about strategies of development which might be undertaken by a school beginning its maths development, and, as the research continued, some comparative views on the effectiveness of the strategies used in terms of teacher development and mathematics practice. There was also the potential for more in-depth study, should the need arise. These schools were visited twice more,

thereby reporting on their development for a further two years (see Appendix 2, Notes on Fellside and St Mary's schools).

3.4.4 Change in research design

A decision taken by the staff of Greenside school at the School Development Plan Inset day in January 1994 to retain 'Using and Applying Mathematics' on the School Development Plan for the succeeding year (see Chapter 4) meant that changes to the research design should be considered. As the mathematics development was to be continued for another year at the school, it seemed it might be preferable to continue with this school as a main focus for another year, rather than to select a second school. In favour of this decision were several factors:

1. The teachers themselves had come to the conclusion that insufficient progress had been made in the implementation of Ma1 for them to move on to something else for the next year.
2. Different strategies for teacher development were to be employed.
3. The researcher was already familiar with, and accepted by, the staff of the school, and time would not have to be spent in a similar lengthy adjustment process with a second school.
4. It would be unprofitable to fail to follow up in depth the changes that were already evident.

There were also several factors militating against such a decision:

1. The concentration on only one school in any depth might restrict the possible factors involved in school mathematics development and teacher development. Comparison with a second school might provide added insights and lead to more purposeful data gathering.
2. The school might not relish another year with the researcher in the school.
3. It was likely that there would be staff movement during the course of an additional year.

I decided that the advantages outlined above outweighed the disadvantages, but the views of the school were of critical importance. As reactions proved favourable, the decision was made to amend the research design to focus on one school for two years, but to maintain contact with the two schools contacted initially that had already commenced their mathematics development (see Appendix 2). The final decision on this change was made after the selection of key informants and the beginning of classroom observation (see Section 3.5.1.2, Phase 2).

The final framework for the research therefore consisted of a case study in one primary school (Greenside School) conducted over a period of just over two years. Section 3.5 describes the methods used for data collection and analysis and outlines the research activities in six phases of the research.

3.5 Data collection and analysis

It is common for qualitative researchers to expend considerable energy in a spate of data collection, and then retire from the field to analyse their results. However this way of working, apart from making analysis into an overwhelming task, rules out the collection of new data to fill in gaps which become evident during analysis. Hypotheses which the researcher makes cannot be tested again in the field; "... the ideal model for data collection and analysis is one that interweaves them from the beginning" (Miles & Huberman 1984, p. 49), enabling the researcher to allow a consideration of the data already gathered to inform the collection of additional data, and to test hypotheses emerging from early data. The concurrent nature of data collection and analysis permitted me to respond to more or less successful aspects of data collection by amending types of questions asked, or ways of approaching participants. It also aided a flexibility in research design as I progressively focused my ideas. For these reasons, data collection and data analysis are considered together in this study, having proceeded together from the beginning of the research.

3.5.1 Overview of the research activities

Phases in the research have been identified primarily by foci on different forms of data collection. However, this does not imply that they have been regarded in isolation from other phases; the holistic nature of the work has been borne in mind at all times. Other forms of data collection (observations collected in fieldnotes, study of school documents) were continuous throughout the time of the research.

3.5.1.1 Phase 1 - September 1993 to February 1994

The primary focus of this phase of the research was the initial interviews. My first task was to familiarise myself with the school, and for them to get to know me. So that this could be achieved with as little disruption and anxiety to the staff as possible, I initially requested visits to their classrooms, with no particular requirements as to subjects being taught at the time. The intention here was to get to know both staff and pupils while avoiding the label of 'mathematics expert'. These were informal observation sessions during which some notes were made, and more detailed fieldnotes later written up. I

took a minor role, if requested, in some classrooms, moving round the room to talk to children about their work. All staff were contacted before I went into their classrooms, and no rooms were visited unannounced.

After half a term of visits to classrooms, and informal talks with teachers in the staffroom, I started to ask each teacher for time for an interview. It had been agreed with the Head that non-contact time could be used for these interviews, and on most occasions it was. On a few occasions lunchtimes were used with the teachers' permission. The timetabling of these interviews was a lengthy business and sometimes resulted in short, but frequent visits to the school. I had underestimated the time in which teachers would be free to be interviewed in the three weeks before Christmas, but the interviews were completed by the end of February. Due to absences of some teachers, I made the decision to make the last two interviews briefer, and supported by notes, rather than transcripts, and this was agreeable to both the teachers involved. Phase 1 ended with an interview with the Headteacher. The initial interviews, and the analysis which followed, are described in greater detail in Section 3.5.2.1.

Throughout Phase 1, the observation of the whole-school approach to the development of this area of maths was also being undertaken. Research activities during this phase of the work included observation of meetings and study of documents. Whole staff, departmental (Infant/Junior) and small group meetings were observed and recorded in fieldnotes. Documents studied included the school booklet for parents, the OFSTED report on the school (OFSTED, 1993b), mathematics curriculum documents in early stages of preparation, school meeting notes and progress reports. Details of the timing of, and participation by teachers in, these activities can be found in Appendix 3, Research activities undertaken at Greenside School.

3.5.1.2 Phase 2 - March 1994 to May 1994

The primary focus of the second phase of the research was the selection of key informants and observation of these teachers in the classroom. At the end of the first phase of the research it became increasingly evident that a selection of key informants should be made in order to rationalise the data collection and enable a progressive focus to be pursued into relationships between beliefs and practice, and how these might be affected by the mathematics development in the school. Johnson (1990) described the selection of informants for a specific reason or purpose as being selected on the basis of judgement sampling: " ... selection is not ad hoc or opportunistic; rather, it is guided by an ethnographer's theoretically and experientially informed judgements" (p. 28). Both

theoretical and experiential judgements informed the choice of the following criteria for the selection of key informants:

1. Key informants should represent both Infant and Junior sections of the school. It had become noticeable that there was some divergence in views between the two sections, most specifically about the appropriateness of implementing Ma1 with young children, and therefore an informant from each section was considered desirable.
2. One key informant should be the maths postholder: an essential informant in relation to the whole-school development of mathematics.
3. The key informants should be willing to be observed in the classroom when undertaking an activity which they had chosen and identified as incorporating Ma1. They should be sufficiently confident about their ability to implement Ma1, to be able to discuss their classroom practice following observation.
4. The key informants should (as far as possible given Criterion 3) exhibit a variety of beliefs about, and approaches towards Ma1.
5. The key informants should be limited in number, as the decision to request in-class support from an advisory teacher meant that it would be productive to observe a wider variety of teachers in classrooms after this form of INSET, which would take place in Phase 3 of the research. Time constraints would therefore limit the amount of classroom observation which could be done with the key informants.
6. The key informants should not be newly qualified teachers. Although the two newly qualified teachers (NQTs) had very interesting ideas about Ma1, I did not consider it fair to put any more pressure on them in their first year, and felt that the school would not be happy about this either.

On the basis of these criteria, four key informants were initially selected and approached: the maths postholder; the curriculum co-ordinator (and Year 4 teacher) who had chosen Ma1 as an area for her own personal development; one of the two Reception teachers, and the Deputy Head who did not have a class responsibility but who did 'investigative maths' by request in most teachers' classrooms.

The selection from the Infant department presented the most problems, as three of the infant teachers showed some lack of commitment either to the need for, or to their ability to implement, Ma1 in their classroom, and one was a NQT. The two Reception teachers spoke most positively about opening up activities and the more overtly confident of these two teachers was selected.

Observation in the classrooms of the key informants followed their selection, together with an observation of an assessment session, suggested by another teacher, and brief conversations with these teachers after the return of the observations to them for validation. The methodology employed for the classroom observations, and type of analysis undertaken are described in Section 3.5.3.2.

Although the focus of this phase of the research was on the selection and observation of key informants, the work of the school as it related to the mathematics development continued to be followed. Two Junior mathematics meetings concerned with the development of the mathematics curriculum document were observed, and an informal meeting was held with the Headteacher. School notes on the meetings which I had also attended and recorded in fieldnotes were studied whenever possible, as were on-going versions of the curriculum documents.

3.5.1.3 Phase 3 - June 1994 to July 1994

Inset sessions and a follow-up meeting conducted by the LEA mathematics adviser provided the main focus of Phase 3. The classroom sessions, held in all year groups (with the exception of Year 5 because of illness) with one class of children, but with both year group teachers released to observe, were conducted by the adviser and observed by me with the permission of both school and adviser. I was also present for any follow up discussion which time permitted. The adviser also led the follow-up meeting to deal with issues arising from the Inset sessions which either teachers or adviser wished to raise. Notes from these observations and from the meeting were returned to the adviser for validation.

A mathematics working group meeting was observed, and ongoing study made of school meeting notes and the mathematics documents. Additionally, the school was developing new planning documents to incorporate all subject areas, and information on the progress of this topic planning document was collected.

3.5.1.4 Phase 4 - September 1994 to November 1994

This phase of the research focused on changes in personnel and roles. One key informant, the mathematics co-ordinator, was taking maternity leave and had no class responsibility during this time. Observations were made of her work in other teachers' classrooms and she was interviewed before she left, as was another member of the maths working group who was leaving at the same time. Three new members of staff (including a new mathematics co-ordinator) were interviewed. During this period of

change, contact was kept up with the Headteacher through two informal interviews. I also observed one of the key informants in the classroom.

Meetings were more frequent as this was the beginning of a new school year. Two mathematics working group meetings were observed, two whole-staff meetings and one departmental meeting. I kept up to date with school documents of both administrative and curricular types.

3.5.1.5 Phase 5 - December 1994 to March 1995

Ongoing analysis of data collected over the first 18 months of the research had indicated varied participation by teachers in the mathematics development. Issues raised by this analysis (see Chapter 8, Section 8.2) needed confirmation, and the research design was therefore amended to include observation in the classrooms of all the teachers who were involved with the research in some significant way (ie. not including supply teachers) and these observations became the primary focus of Phase 5 (see also Section 3.5.3.2). Observations were returned to the teachers concerned for validation, and wherever possible discussions were held after they had had time to read and reflect upon them. However, time constraints sometimes precluded more than a few minutes being given to these sessions.

The new School Development Plan was given careful attention, as were the notes on meetings and on-going curriculum drafts.

3.5.1.6 Phase 6 - April 1995 to December 1995

The primary focus of Phase 6 consisted of final interviews with the teachers concerned. These interviews are described in Section 3.5.2.2. These interviews were completed by July 1995 and my contact with the school became one of keeping in touch, which I did through brief and informal interviews with mathematics co-ordinator and Headteacher over the remaining term. Vignettes of the key informants (see Appendix 4) were sent to them for validation. School documents were kept for me to collect on these informal visits and I was thus able to monitor changes to and developments in these over the remaining months of the research.

3.5.2 Interview

Interviewing was used in this research in a variety of contexts, ranging from the opportunistic and unplanned to the carefully planned and structured. On many occasions during my time in the school, opportunities presented themselves for brief conversations with the headteacher or with individual teachers and these were gratefully snatched and made use of. Other conversations were planned but informal. These short sessions - sometimes related to keeping up to date with ongoing events or happenings in the school, sometimes to the return of observations to teachers, sometimes to unexpected issues which arose spontaneously - were documented in fieldnotes. Two sets of interviews were planned as part of the research design, and are described in the following sections.

3.5.2.1 Initial interviews

Given Fullan and Hargreaves (1992a) emphases on the categories of 'purpose' and 'person' (p. 5), it was anticipated that such data would be central to later analyses. The initial interviews aimed to explore teachers beliefs about mathematics and their views on how they were implementing Ma1 at that time, their perceptions of the reasons behind mathematics (and particularly Ma1) being selected for the school focus and identification of needs in both school and personal terms.

At the same time, information was collected, as far as possible, on individuals' careers to date, in both objective and subjective terms (Ball and Goodson, 1985; Goodson, 1988). Another focus for the initial interviews was in establishing views about the strategies that the school intended to use when working on the maths focus (eg. non-contact time for the co-ordinator or other teachers to work in each other's classrooms; use of outside advisory contributions; timetabling of meetings etc.).

These initial interviews were unstructured, in that I had no set list of questions, but semi-structured in that I had a set agenda, as described above, that I wished to cover with each teacher, but did not necessarily always want to approach in the same way. I wanted to remain flexible enough to respond to comments that arose in the interviews, and follow the flow of the interviewee. However there was several issues which I attempted to cover in each interview, if they were not raised by the teachers themselves: in some cases, because of lack of time, or unforeseen happenings, some issues were left uncovered. Teachers were generally asked at the beginning of the interview to describe some mathematics they had recently done in their classroom, or some mathematics that they had enjoyed doing recently. This initial question had been used successfully in the Mathematics Evaluation Project (Askew et al., 1993) in enabling the interviewer to

establish a reasonable picture of how the teacher approached mathematics in her classroom, which could be used as a starting point for further questions. The design of this type of question, a 'descriptive' question, was suggested by Spradley (1979),"don't ask for meaning, ask for use" (p. 97), as a way of encouraging informants to reveal relationships between terms or ideas. 'Structural' and 'contrast' questions (p. 60) were also included, when appropriate.

Interviewees were generally asked about the extent and type of use of the commercial mathematics scheme which had been adopted by the school three years previously, and of other commercially produced materials. The characteristics of scheme use sometimes emerged from a description of the mathematics in the classroom, and needed only a probe to establish more detail. Sometimes, however, it was asked as a specific question. The range of attainment that teachers had to address frequently arose spontaneously and was followed up by questions on strategies for differentiation.

Teachers were asked about their approach to Ma1, 'Using and Applying Mathematics'. If possible this subject was raised through the answer to a more general question, as it became more and more noticeable that teachers were reluctant to describe their practice in Ma1. The responses to this question determined the length and depth of further probes. Some teachers were asked about differentiation and progression in Ma1, some were not, if the judgement of the interviewer was that this would not be profitable because of feelings of anxiety which were emerging. Teachers' careers to date, their experience and their roles within the school usually arose during the interview; if personal details were readily given, they were recorded in the transcripts. The school's interest in, and development of, 'practical/investigational mathematics', as mentioned on the School Development Plan, was also raised whenever possible.

These interviews took place over several weeks, and were transcribed immediately after the interview. The transcripts were handed back to the interviewees for respondent validation, and an interview impression and summary form (Miles and Huberman, 1984) were written to accompany the copy of the transcript to be coded.

The initial stage in the analysis of the interview transcripts was that of 'open coding' (Strauss & Corbin, 1990, p. 61). The coding categories developed in several stages. Sometimes the labels placed on events or views expressed proved on subsequent comparison with others to be too broad, to reflect more than one attribute or characteristic of a category, and this led to the identification of different properties of that category. At other times, comparison of conceptual labels led to them being

grouped together as they appeared to "pertain to a similar phenomenon" (p. 61). As Powney and Watts (1987) found, they had to "look again at the categories as they are beginning to look a little crude, a little too inclusive, and they overlook some of the subtlety of the evidence which currently supports them" (p. 105), employing the constant comparative methods of analysis (Glaser and Strauss (1967, p. 105) to do this. A full coding framework is given in Appendix 5a. Expanded versions of the larger categories of "Aspects of Management", "Maths Development" and "Attitudes to 'Using and Applying Mathematics'", are given in Appendices 5b, c and d, respectively.

The analysis of the first few interviews proceeded while other interviews were in progress, and, in line with the use of grounded theory (Glaser & Strauss, 1967), initial indications from these first interviews guided the development of questions for further interviews. As Porter (1984) described, after working on her first set of transcripts:

> This allowed us fully to refine the categories that were emerging, and to arrange them in a schedule for future interviewing. (p. 151)

The initial analysis of interviews affected particularly the style of questioning about Ma1. More effort was made to draw references to Ma1 out of the teachers' responses, rather than asking a direct question. It also affected the focus of discussions about Ma1. Initial analysis of interviews had indicated certain preconceptions about the implementation of Ma1, and these were made specific in later interviews. For example several teachers voiced the opinion that a teacher's ability to implement Ma1 was closely related to the behaviour of children in her class. Later interviewees were asked about this specifically wherever possible.

A researcher's role as participant observer can never remain static, as familiarity with the culture being studied increases, and the members of that culture become better known to the researcher. Ball (1984) described how "the hierarchical nature of the researcher-respondent relationship is broken down" (p. 81), with the hope of thereby generating a collaborative approach. This was quite evident in my research. After I had been in the school for a term, I could not avoid being known as a person with some opinions; as more conversation was directed towards me I was involved in more interaction. In other words, social intercourse became more of a two-way process. I was able to maintain a strictly observational role in formal meetings, but in informal contacts it was inevitable that I should be reciprocating in conversations. I came to know some staff better than others, and in several of the later interviews I felt it necessary to take this more informal relationship into the interviews. Porter (1984) described being asked for advice in her second round of interviews and feeling that,

although it raised the issue of altering the course of events in the area being studied, there was "a commitment to the students which would not allow total detachment from their interests" (Porter, 1984, p. 157). Oakley (1981) also felt this imperative, believing that it was not ethically or methodologically sound to deny the questions put to the interviewer by an interviewee by claiming ignorance, as a more traditional, positivistic model would demand. "I did not regard it as reasonable to a adopt a purely exploitative attitude to interviewees as sources of data" (Oakley, 1981, p. 48). In addition to responding more to direct questions in the later interviews which I conducted, I also found it possible to incorporate into later interviews information which had become available by being made public at these meetings, and later interviewees had had time to reflect on these meetings before they were interviewed. A selection of extracts from initial interviews is given in Appendix 6. These extracts show initial coding and researcher comments.

The interviews were analysed further, particularly those aspects related to Ma1, giving a picture of the variety of beliefs existing in the school, the degree to which these were shared, and how they fitted into the framework of the attainment target itself (see Appendix 7a, Table 7.1, Stranding analysis - 1). This enabled links to be made between teachers' views and classroom practice observed by the researcher.

3.5.2.2 Final interviews

The final interviews took place at the end of two school years of fieldwork (except in the case of one key informant who left before this, and whose interview was conducted as a pilot for the design of the final interviews); their purpose was to encourage teachers to reflect on possible changes over time in their own views and practice, and, on a wider scale, those of their colleagues both individually and as a group. Their design was more tightly structured than the initial interviews in response to the identification of a number of issues which had arisen during the course of the research, and on which clarification was sought.

A selection of their own comments or views, expressed either at the earlier interview, or noted in fieldnotes, was presented to each teacher, with a request for them to indicate whether they still held these views, or whether their views had changed. They were also asked to comment on whether their colleagues might share these views. They were then all asked the same set of questions relating to Ma1 in terms of their perception of individual and whole-school progress, and their intentions for Ma1 in their own classroom. Their opinions were then elicited on the descriptive categories which I had used in the mapping analysis (see Chapter 8 and Appendix 8) to categorise teachers'

responses to the mathematics development in the school. (A full set of the questions asked at the final interviews is given in Appendix 9.). Two teachers were not able to make time for this interview. One responded in writing, one did not.

These interviews were tape recorded, but, in this case, summarised rather than transcribed. Subsequent analysis was thematic; certain clear issues were emerging from these interviews which were raised by a majority of the teachers. These were grouped together in themes relevant to the mathematics development which the school had been undertaking. A comparison was made to investigate change in beliefs over time and the stranding analysis was returned to (see Appendix 7b, Table 7.2, Stranding analysis - 2) . (A selection of final interview summaries is given in Appendix 10.)

3.5.3 Observation

As with interviewing, observation was used in a variety of contexts ranging from informal situations to more formal meetings and classroom interactions planned for in advance.

3.5.3.1 Observations recorded in fieldnotes

I was observing from the minute I walked into the school on each visit, to the minute I left. Porter (1984) discussed, in relation to interviewing, the degree of knowledge about an informant's social world which was necessary in order to be able to ask relevant questions and understand the answers. Similarly with observation; my background in primary teaching and management made me aware of a very wide range of issues and behaviours which were relevant to my study. I noticed how people greeted each other, how they walked about, whether the lavatories had clean towels, whether meeting notes were up to date, whether people were late for meetings, how people related to each other. These were, of course, not the only things that I noticed but they were, to my mind, of importance. They were noted in fieldnotes. I kept a notebook with me at all times, and took advantage of times between interviews or observations to write notes down.

My presence and note-taking at meetings was more public - it was quite obvious to all that I was recording the meeting in some way, although later in the research my presence seemed to be so familiar that teachers forgot that I was there. I was careful to place myself in non-focal positions, and to be aware that my facial responses might be noticed. I did not record these sessions, but made detailed notes, and was frequently able to capture quotations from individual teachers.

I was observing in a big school, and on many occasions people who came into the school only occasionally did not know who I was. I tried to talk to everybody, to explain my presence, to be interested in all aspects of school life. Of course, some participants in the life of the school were more forthcoming than others, more interested in my work, more anxious to talk about their own. I got to know some teachers much better than others. Sometimes, when their responsibilities changed, I got to know them less because they had less time for me.

These fieldnotes were written up, usually the same day, when I got home. In this writing I tried to keep separate my observations and my interpretations, writing the latter as comments at the side. The fieldnotes were coded in the same way as the interviews. Many of the same coding categories were appropriate, although the focus in fieldnotes was more frequently on aspects of the management of the school. (A selection of fieldnotes, showing initial coding and annotation is given in Appendix 11.)

3.5.3.2 Classroom observations

Close consideration was given to the most appropriate method to be used for observing the teaching of the key informants, and later, all the classroom teachers. Checklists and category systems have been used, and also criticised, extensively in classroom research. Walker and Adelman (1975) described them as "essentially for studying variations between classrooms rather than within classrooms" (p. 137), and Delamont and Hamilton (1993) identified seven major criticisms of coding schedules, one of these being a focus on small bits of behaviour rather than global concepts. I was anxious to capture as complete a record as possible of teacher talk and behaviour, and teacher/pupil talk and behaviour, but remain free to limit the breadth if the situation required. The use of pre-specified category systems may assume the truth of what they claim to be explaining. I was anxious to be able to reflect on potential underlying meanings behind teacher talk and behaviour, and was therefore not prepared to make on-the-spot decisions during the observation. "...ethnographic research clearly dissociates itself from the 'a priori' reductionism inherent in the prespecified coding systems. In a very real sense, then, it operates with an open and 'unfinished' methodology" (Delamont and Hamilton, 1993 p. 36).

The observation procedure which I adopted followed from these considerations and my tools consisted of a note-sheet, a table-top tape recorder, and wherever possible, a lapel microphone and recorder to be used by the teacher. The observations were written up

from these three sources (the tapes were not transcribed) and then analysed. Bearing in mind that the purpose of these observations was to explore links between teachers' beliefs and practice related to the sorts of teacher strategies and pupil behaviours involved in the implementation of Ma1, the framework for analysis was drawn from previous work in the analysis of strategies and behaviours in this area. Askew et al (1993) had identified a set of strategies being used by teachers exhibiting promising practice in the implementation of Ma1. These were used in the analysis of observations, together with a set of desirable pupil behaviours derived from the attainment target itself, and presented in Mathematics Programmes of Study, INSET for Key Stages 1, 2 and 3 (NCC, 1991) (see Appendix 12). In addition, other appropriate strategies identified by researchers working on the Development of a Taxonomy of Primary Teachers' Scaffolding Strategies in Three Contexts (ESRC 1992-94) were used.

The classroom observations were written up from notes and tape recordings, and annotated by drawing out aspects of the lessons particularly related to teacher strategies and desirable pupil activities involved in the implementation of Ma1. Some sections of the lessons were written up in more detail than others, depending on the activity of pupils, teacher/pupil discussion, etc. These observations were passed back to the teachers concerned for validation, and comments on the analysis were noted. (A selection of annotated observations can be found in Appendix 13). Several short in-class sessions undertaken by the mathematics co-ordinator were also observed and recorded in note form.

I was also able to observe the Inset sessions conducted by the mathematics adviser. On these occasions, only one tape recorder was used. My intention was to observe not only the adviser, and how she related to the pupils, but also the responses of the watching teachers. I therefore took more of a background role than in the classroom observations, and the write-ups contained fewer pupil/teacher conversations. The sessions were summarised and notes were written which attempted to briefly document the responses of the teachers both during and after the activity initiated by the adviser. The full notes were returned to the adviser for respondent validation (a selection of these, together with notes on the Inset meeting which followed them, is given in Appendix 14).

3.5.4 Study of school documents

The Headteacher and mathematics co-ordinator were extremely conscientious in making school documents available to me, and I rarely had to ask. Notes of all school meetings, including those relating to the School Development Plan, were made accessible for me to use and to copy if I so wished. Copies of all relevant curriculum documents were kept for me, as soon as they were produced. I had the run of the resources room to keep materials and resources under review. I was given the school booklet for parents, the job description of the mathematics co-ordinator, the OFSTED report on the school, as part of the pilot study in 1993, (OFSTED, 1993b). These documents were used in a confirmatory way, often for factual information, but also to support the analysis emanating from other data sources.

3.5.5 Summary

Table 3.1 summarises the research activities undertaken during the different phases of the research. (A more detailed version, Table 3.2, is available in Appendix 3.)

Phase of research	Research activities
1. Sept '93 - Feb '94	Familiarisation with teachers and classrooms. Initial interviews with all teachers (17). Informal meeting and interview with Headteacher. Return of transcripts for respondent validation. Observation of mathematics working group (WG) meeting (1); Infant meetings (2) and whole-staff meetings (4). Report from maths co-ordinator (MC) on meeting with LEA maths adviser. Study of: school documents and mathematics resources; school booklet; OFSTED report; mathematics curriculum document (early stages); notes on staff meetings; progress reports on School Development Plan (SDP); new SDP.
2 March '94 - May '94	Selection of key informants (KIs) (4). Observation of KIs in classroom (5 sessions). Observation in Yr2 classroom (1); mathematics WG meeting (1); Junior meetings (2). Return of observation notes for validation. Informal meeting with Head. Study of: mathematics resources; curriculum documents in preparation; school notes on meetings.

Table 3.1 Summary of research activities at Greenside School from September 1993 to December 1996

Table 3.1 contd.

Phase of research	Research activities
3. June '94 - July '94	Observation of in-class Inset sessions (6) and Inset Meeting led by LEA maths adviser. Return of Inset notes to adviser for validation. Observation of mathematics WG meeting (1). Study of: mathematics and topic-based curriculum documents in preparation; school notes on meetings; resources.
4. Sept '94 - Nov '94	Interviews with new teachers including new MC (3). Interview with outgoing MC. Observation of outgoing MC sessions in classrooms (2). Return of notes to co-ordinator for validation. Observation of KI (1). Observation of mathematics WG meetings (2); departmental meeting (1) and whole-staff meetings connected wholly or partly with mathematics (2). Two informal interviews with Headteacher. Study of: mathematics and topic-based curriculum documents; mathematics resources; school notes on meetings.
5. Dec '94 - March '95	Observation of one maths lesson in each classroom (17). Observation of mathematics WG meeting (1); departmental meetings (2) and whole-staff meetings (3). Observation notes returned to teachers for respondent validation. Two informal interviews with the Head, recorded in fieldnotes. Final interview with KI (curriculum co-ordinator). Study of: school planning documents once again under review; mathematics resources; school notes on meetings; new SDP.
6. April '95 - Dec '95	Final interviews with teachers participating in the research (14). Informal interview with MC, recorded in fieldnotes. Two informal interviews with the Head, recorded in fieldnotes. Return of vignettes to KIs for respondent validation. Study of report by MC of monitoring process at Key Stage 2

Table 3.1 Summary of research activities at Greenside School from September 1993 to December 1996 (contd.)

Section 3.5 has described the analysis of data collected from three main sources: interviews with individual teachers; observations of on-going school activities, meetings and classroom teaching, and a study of school documents. The breadth and

variety of the data collected is indicated in Table 3.1. Data collected in both formal and informal situations were incorporated into data analysis in an on-going and continuous way throughout the research. It became apparent that there were different ways in which further comparative analyses of the data collected from these three sources could be approached - different ways in which the data could be 'sliced'.

A horizontal cut facilitated comparison at three levels - of the whole school, the group and the individual. A focus on the whole school, and particularly aspects of its management, fed directly into the analysis of the school's culture, described in Chapter 5; the beliefs and views about mathematics held by individuals compared both within and between individuals, led to the analysis of communality of beliefs, the stranding analysis, both described in Chapter 7, and the mapping analysis described in Chapter 8. Later thematic analysis of the final interviews identified issues connected with change over time, also reported in Chapter 8.

A vertical cut looked at how an individual might relate to both groups and to whole school responsibilities, working with a set of beliefs and views within a specific role. The analysis of the role of the mathematics co-ordinator was the result of this approach to the data and provides the content of Chapter 6.

Useful though these ways of looking at the data have been in order to generate analysis, the integrated nature of the 'whole' has not been forgotten; the inter-relatedness of its parts, their dependency and effect one upon another have remained an important focus of the research.

3.6 Conclusion

This research was conceived during a time of change and uncertainty in primary education, and particularly in mathematics education. The research literature and my own experience in primary schools provided a foundation for the making of choices not only in the research questions to be posed, but also in the choice of context and methods of data collection and analysis with which to approach them - choices which have been described in this chapter.

The next chapter takes the reader into Greenside School, a large primary school in an outer metropolitan area - the 'case' of this case study - and subsequent chapters present the school, its teachers and its ways of working through the voices of the teachers as individuals and as members of a community, and through my eyes as the observer.

Chapter 4. Setting the scene - the school and the mathematics development programme

4.1 Introduction

The selection of Greenside School was described in Chapter 3. The following vignette is an account of the feel of the school as experienced by an outsider, well informed in general about primary schools, but open to messages coming to me from this school in particular. Inevitably the selection process itself had involved making some initial judgements about the school, but the early visits to the school and the classrooms were designed to provide an opportunity for the feel of the school to become apparent.

Having set the scene with a picture of the school, an outline is then given of the course of the mathematics development over three years, detailing the sorts of activities engaged in, and strategies pursued, within the context of external events affecting the school. This to enable the reader to link the more detailed discussion of the intentions behind, and responses to, these activities and strategies (at whole-school, working group and individual levels) in subsequent chapters, with the time span of development.

4.2 Greenside School - a vignette

Two years ago the road leading up to Greenside School had no sleeping policemen to slow the motorist down, but the estate of new houses built during that time has increased the amount of traffic up the road, and the dead end at the top makes turning and manoeuvring very difficult. As the driver passes small suburban houses with gardens at the front as well as the back, it looks as though the road peters out into a field. But once at the top, the ground slopes away steeply to the right to reveal a large school set down from the road, surrounded by grass and trees.

The buildings are modern, partly single and partly two-storey, with large lower windows and doors from the ground floor classrooms opening out onto paved walkways. The entrance is a bridge between the two departments, Juniors to the left and Infants and Nursery to the right, with a facing display which often features work from across the whole range of pupils, from Year 6 to the Nursery. A large hall downstairs can just accommodate the whole school. It is more usual for the two departments to meet separately, using an additional hall on the first floor for Junior assemblies.

Directions are clear and unambiguous. Everyone must report to the office. Once in the office, the purposeful feel and efficiency of the school first become apparent. Appointments are kept, arrangements are made, reminders are given; all without fuss or irritation. There is an orderly feel, too, about the children. In and out of classrooms, to and from Assembly, along the long corridors, they muster and disperse sensibly. Adults speak to children quietly and politely and children respond well.

This is a big primary school, two form entry apart from a Reception year of three form entry, which has expanded during the last two years to cater now for 470 pupils. The 50 place Nursery dates from 1990, and could expand if space were available. There is a great deal of walking to do. The long Infant corridor extends past six classes to the Nursery at the far end. The common sight of small children carrying large bins filled with lunch boxes is an initial surprise. No hot lunches are now provided by the borough at this school, so all children bring packed lunches, with 20 taking up the option of free school meals, although more are eligible. The kitchen has been transformed into a classroom as the school has expanded, and two additional temporary classrooms at the rear of the building have since been added. The junior department, on two levels, has shorter corridors, but in both departments the corridors are wide enough to provide seating and display tables, as well as space for books, computers and play materials. To many teachers, working in less favourable environments, the classrooms would seem spacious, light and airy. However, as numbers rise above 30, children's movement in the rooms seems restricted, particularly among the larger, junior age children, and display space becomes limited. Great efforts are made to keep the physical environment colourful and well-maintained. Displays change frequently to keep pace with current work, and children's efforts to produce work of a high quality are clearly valued.

According to the OFSTED report (OFSTED, 1993b) dating from July 1993 (the school was in the pilot cohort), this school caters for a very average range of attainment and social class, with few if any extremes at either end. The catchment area includes both private and social housing. The local community has not escaped unemployment and family difficulties, and the feeling within the school is that provision for special needs is required to be more extensive than it was in the past. Out of a total roll of 470 pupils, 2 children are statemented, with others identified as having problems which necessitate extra help, even if only temporarily. The SATs results from 1995 at KS1 indicated roughly similar percentages across the levels as in the national comparative information for 1994 in reading and mathematics. Higher percentages in level 3 in spelling were achieved, with lower percentages in writing and handwriting. At KS2 the first year of

reported SATs revealed modal levels at level 3 for English and mathematics, and level 4 for science.

A large school has a large staff. As in all schools some teachers are much more in evidence to the visitor than others, who tend to spend more time in their classrooms, and less in the central areas and the staffroom. The staffroom is not inviting by its very shape - it was created from a corridor and is thus long and narrow, with rows of chairs facing each other which have to be dragged round at the ends to achieve a shape even remotely appropriate for a meeting. The ages of the staff range from those young and newly qualified to those coming towards the end of their careers and nearing retirement age, several of whom have taken time out of teaching either full or part-time to bring up families. All are female except for one Junior teacher and the Deputy Head. Social and professional relationships are both apparent in the staffroom; usually easy, sometimes less so, as in any institution.

The school has experienced a considerable degree of staff turnover in recent years and now only four teachers out of the seventeen pre-date the Head's appointment in 1990. From comments made by teachers it would seem that the more traditional arrangement of separate teachers in separate classrooms meeting to make administrative rather than curricular decisions has been gradually replaced by a culture which values collaboration and seeks to involve all members of staff in decision-making, yet with strong but flexible leadership still remaining in evidence. The added demands which this style of management makes on teachers have not necessarily fitted with all teachers' feelings of where their priorities lie. However, this latter culture appears, to the outsider, to now dominate and there is a feeling of coherence in approaches to behaviour (also noted by OFSTED); to the importance of school development and working together and towards the importance of an attractive environment for children.

Although 'average' in some respects, this school is not 'typical' in the sense that it was chosen for a specific reason, and because it had certain attributes. The apparent whole-school nature of its decision-making with the decision made in 1993 to focus on 'practical/investigational mathematics' made it a candidate for selection for the research. The feel of the school and the initial impression about the nature of its management and the degree of acceptance of that management by those working within the school, the consultative process of negotiation with staff and the positive feeling noted at my first meeting with the staff indicated that this was a school which was willing to grapple with difficult areas and participate in a learning process. These perceptions were strengthened, rather than diminished over the course of the research.

Initial impressions on the general feel and ethos of the school remained intact. Increasing familiarity with teachers and classrooms revealed differences in teaching style and classroom management, but these differences, while spanning a continuum, did not appear extreme. The arrival of the National Curriculum seemed, to some teachers, to have had important consequences for their style of teaching and classroom organisation.

4.3 The mathematics plan and strategies for development

4.3.1 Nomenclature

The nomenclature surrounding the first attainment target in the 1991 mathematics National Curriculum has been described in the research context (Chapter 1) but needs re-definition here as different ways of describing the target become apparent in the writing that follows. In previous writing and research I and others have accepted the generally used title of the first maths attainment target in the 1991 document as 'Ma1' or 'Using and Applying Mathematics' (as it is now referred to in the 1995 version of the curriculum document). Teachers at Greenside School, almost without exception, used the term AT1 to describe this attainment target, no doubt the history of its development from Attainment targets 1 and 9 in the 1989 document creating this use of the term. I have therefore retained the use of AT1 in all quotations from school documents, interviews, observations and fieldnotes as appropriate, but have continued to use Ma1 or 'Using and Applying Mathematics' in the general body of writing.

It is also necessary to consider other mathematical terms. The words 'investigational' 'investigative' and 'investigation' are used throughout this study to describe classroom activities in mathematics at Greenside School. The use of these words by different teachers appeared to have slightly different meanings: for some teachers there was no clear idea of meaning. The words were associated with 'Using and Applying Mathematics', this association evolving partly from recommendations from the borough about the implementation of Ma1. They were associated with the teacher standing back, with pupils taking things on if they could. They were associated with feelings of uncertainty, fear and insecurity on behalf of the teachers - ideas of open-endedness, of questions without any definite answer, of pupils reaching stages that the teacher had not reached - all contributed to these anxieties.

The following quotations from the initial interviews, all referring to 'investigations' or 'investigative' work, illustrate the wide range of meanings associated with the words.

... like getting information from a graph, or they'd be shopping and find out how many ways can you make a 10p and coin recognition.

Like the science though isn't it, there's a bigger focus on ***investigations*** *in Science now this year as well. They're both quite hard actually to get them to do the questioning, rather than you just doing it.*

Well, science is my area so I have to sort of do that one, but I find that quite easy to organise because you pose them with a question, then they have to sort out how they're going to find the answer to that question, or at least explore that question, so they come up with all the ideas themselves, and as long as they're on the right track, they're a legitimate ***investigation*** *for them, and they say what they need and everything. Whereas in maths, you can't really ... well I've never tried ... I didn't know what kind of open-ended question to start them off with, and then I don't know, I just find that a lot more difficult to say, right, we're going to find out ... I don't know you'd even ask them to find out that they had to think about, what they needed to find out the answers.*

... and it's not as if, you know, you're not going to mark it right or wrong, and that's the thing I think with ***investigations,*** *they can do it as far as they can, and say, right, yes we've done that ... .*

...which was the calculator ***investigation,*** *where they were basically familiarising themselves with calculator keys, but also doing addition, basic addition,* ***investigation*** *and problem solving in terms of having a specific goal to try and aim for, to find a word that equalled a certain value on the calculator. And I found that enjoyable mainly because everyone could pitch it at their own level and it was possible to monitor how they were working, and they were working well collaboratively together, so there was a lot of mathematical discussion going on, which I find sometimes doesn't happen, because it tends to be "Have I got the right answers to the right numbers?" and that's their main objective.*

Because I think really what it is, is that an ***investigation*** *is a fairly ... where you actually relax the control and the children take the control, if you're going to do it with purely open-ended, and some people I think find that difficult, and sort of are insecure with that. And I think it's the same with science as well. [...]*

People were saying ... "What should I be doing? Should it be totally open-ended? Has an investigation got to have no answer at all?" That sort of thing.

These examples of the use of mathematical language exemplify the variations in interpretations of the terms from teacher to teacher; these interpretations in turn affecting the way they viewed their responsibilities under the School Development Plan.

4.3.2 The starting point

Mathematics made its appearance on Greenside's School Development Plan for 1993-94, in response to teachers expressing anxiety about their implementation of 'practical and investigational maths' at the Inset day in January 1993 and giving it priority in terms of a focus for development. Perusal of previous years' development plans indicated that mathematics had not been regarded for several years as an area needing development.

From the initial visit to the school and discussion with the Headteacher and maths co-ordinator it appeared that they, too, were keen for this issue to be addressed. The OFSTED report (OFSTED, 1993b) had also noted the need for more opportunities for pupils to "apply numeracy skills in real life contexts" (OFSTED, 1993b, p. 13).

Both Headteacher and maths co-ordinator felt that mathematics practice in the school lacked coherence. Variations in practice between classes and between departments (Infant and Junior) were causing concern, some of these variations relating to the use made of the commercial scheme (see Appendix 1, Notes on schools visited during the selection process). In 1990 the decision had been taken to review the school's mathematics commercial scheme. It was felt by a majority of the teachers that they needed the support of a new scheme and additional resources with which to implement the National Curriculum. The Ginn scheme (Ginn, 1984) had been used in the past, but this was now felt to be inadequate and out of date, and it was decided after discussion that Peak (Peak, 1989) mathematics should be used throughout the school. At that time, 1990-1991, teachers were apparently feeling that they did not want further discussion of the core subjects and the Headteacher indicated that no clear identification of needs was made. Since then a variety of other supplementary materials have been bought, and Ginn is still used to some degree.

Four objectives were set in January 1993 for the co-ordinator and maths working group:

- To evaluate and bring to the attention of staff existing investigational/practical ideas;
- To review any new resources available with a view to extending existing school resources (particularly for AT1);
- To collate a school bank of ideas;
- To review the progression of skills used for investigation/practical work throughout the school.

These objectives (taken from the Greenside School Development Plan 1993-94) were to be achieved through encouragement of staff to use existing resources, to share ideas and to attend twilight sessions on mathematics. In-class support from advisory staff was also considered to be necessary. The success criteria identified were the "establishment of a school bank of ideas, increased confidence in the use by staff of practical/investigational ideas with children and the reflection of AT1 in planning" (SDP, 1993-94).

4.3.3 The first year

Between the start-date of the plan (April 1993) and my initial visit to the school in July 1993, it had been decided that the fourth objective should be given top priority, and should be broadened in scope to include all the maths attainment targets, thereby producing a new maths progression for the school. The reasoning behind this decision was that a progression for Ma1 alone was neither possible nor desirable; an approach was needed which incorporated Ma1 with the other maths attainment targets.

The maths adviser for the borough had given a twilight session on Ma1 in June 1993. According to the maths co-ordinator, this had been received enthusiastically by all staff. The adviser had laid great emphasis on the fact that they did not need new resources to implement Ma1, and had suggested various ideas for them to try.

During the course of the Autumn Term (1993), the postholder worked on the maths progression, getting ideas in writing from members of staff, starting to collate these with reference to the National Curriculum and the school's previous scheme of work, and returning them for discussion at departmental meetings (Infant and Junior). The Infant staff discussed progress so far at an Infant staff meeting, but there was no time to organise a meeting with the Junior staff before the end of that term. The co-ordinator and the other member of the maths working group also started on the process of collecting together a folder of investigative activities, and organised all the maths resources which were not in classrooms to form a section of the new Resources Room.

The Inset day for the School Development Plan for 1994-95 was held in January 1994, and at this meeting staff again expressed anxiety about Ma1 to the extent that it was given high priority once again as an area urgently requiring attention and development. It was decided that Ma1 should be retained on the School Development Plan for another year (now to be called 'Using and Applying Mathematics' rather than practical/investigational mathematics), with the strategy of advisory help and observation in the classroom being requested as the one most likely to be helpful to teachers.

Although taken aback at this expression of group feeling of lack of progress, the co-ordinator, supported by the other member of the working group, persevered with the writing of the maths progression, a long and arduous task involving as it did a process of consultation with groups of staff at frequent intervals - a way of working favoured by the maths co-ordinator because she was able to take on board the views and ideas of members of staff at each stage in the writing. This progression had then to be adapted to fit into the whole-school curriculum planning document organised round topics, with opportunities being identified for pupils to experience maths linked to topic work as well as aspects of maths which were on-going throughout the year.

Consultation with the maths adviser resulted in the decision to include investigative activities in the whole-school curriculum planning document for each half term to provide, initially at any rate, assessment opportunities for Ma1.

4.3.4 The second year

The maths co-ordinator continued her work on the curriculum planning documents and the maths progression. The folder of investigative activities continued to be added to, but suitable activities had not, at this point, been incorporated in the curriculum documents.

At the SDP Inset meeting in January 1994, teachers had requested in-class sessions from the adviser which they could observe, indicating that examples of what could be done with a whole class would be of most use to them. These sessions were planned for and subsequently carried out in June 1994. The mathematics adviser for the borough conducted activities with each year group (except Year 5), with supply cover provided so that both year group teachers could observe. There was time for discussion after the sessions, and a longer, after school Inset Meeting was held the following week to discuss issues arising from these visits.

The co-ordinator's contribution to both these planning documents, the maths progression and the curriculum planning document, had to be completed before half-term, October 1994, when she left to take maternity leave (as did the other member of the mathematics working group). Newly constituted working group meetings to discuss 'Using and Applying Mathematics' and data handling were held, and these reported back to full staff meetings. During the early part of this autumn term, the co-ordinator had no class responsibility and was able to provide some in-class mathematics support (when she was not required to cover illness).

The new co-ordinator's task was initially to focus on the selection of suitable activities to be included in the curriculum planning document, to continue to up-date the folder of activities and monitor resources. The additional task of incorporating ideas from the Dearing review and the new version of the mathematics National Curriculum also fell to her. Working group and departmental meetings led by the new co-ordinator provided opportunities for discussion and selection of activities, centred round a variety of mathematics attainment targets, to include in the planning documents.

At the Inset day for the School Development Plan (1995-96) held in January 1995, priorities were again discussed, but on this occasion the implementation of 'Using and Applying Mathematics' was not felt, by the majority of teachers, to remain a top priority. Several teachers felt that the area had been covered sufficiently over the course of the past two years, although others did not share these views. The context for these discussions included the major review of the curriculum planning document which the Dearing review and the new curriculum would inevitably mean, and the plans (at that time) to enlarge the school to three-form entry. Other areas of school life had assumed priority.

Towards the end of the second year of development (January - March 1995), teachers were beginning to work with the selected investigative activities in the classroom. Levelling meetings for both Infants and Juniors were organised to discuss assessment at different National Curriculum levels, and an investigative mathematics activity was chosen as the focus for these meetings.

4.3.5 Ongoing development

Although the development of 'Using and Applying Mathematics' was officially at an end in terms of the School Development Plan, the school had made provision for ongoing development to be supported by up-grading the role of the co-ordinator (a

priority in the 1995-96 SDP) to include a monitoring role; by providing the supply cover for this task to be undertaken, and by selecting the maths co-ordinator as the first to take on this role. The co-ordinator was undertaking this work at the time that the fieldwork in the school came to an end.

Figure 4.1 summarises the time line for both school strategies and activities in the maths input, and concurrent outside events. Phases of the research (referred to in Chapter 3) are also indicated.

4.4 Conclusion

The intention of this chapter has been to set the scene for the work that follows. The remaining introductions which need to be made are of the teachers themselves. It is, of course, realised that the many other people working with pupils in the school - the administrative staff, the classroom helpers, the caretaker, the dinner ladies, the peripatetic staff, the parent helpers - have all contributed to this research in some way. However, they do not constitute the focus of the research; that remains with the teachers.

Appendix 15 contains a list of all the teachers who made significant contributions to the research. Supply teachers (with one long-term exception), and teachers coming new to the school in September 1995, have not been included. Individual teachers make their appearance in the text as the story of the mathematics development at Greenside School unfolds.

The teachers are all referred to by pseudonyms, as is the school and the local authority adviser. Great efforts have been made to ensure that the anonymity of the staff has been maintained. To assist the reader in establishing roles within the school and in linking these with names, the following abbreviations are used in the text. Deputy Head (DH), curriculum and assessment co-ordinator (CC), mathematics co-ordinator (MC), Junior co-ordinator (JC), Infant co-ordinator (IC), key informant (KI), mathematics working group member, 1993-94 (WG1), mathematics working group member, 1994-95 (WG2). It should also be noted that 'Headteacher' is used throughout when discussing the holder of that position. This terminology has been used solely to facilitate identification, and not to indicate that this headteacher was viewed in a formal or distant way by the staff. She was on first-name terms with both teaching and administrative staff.

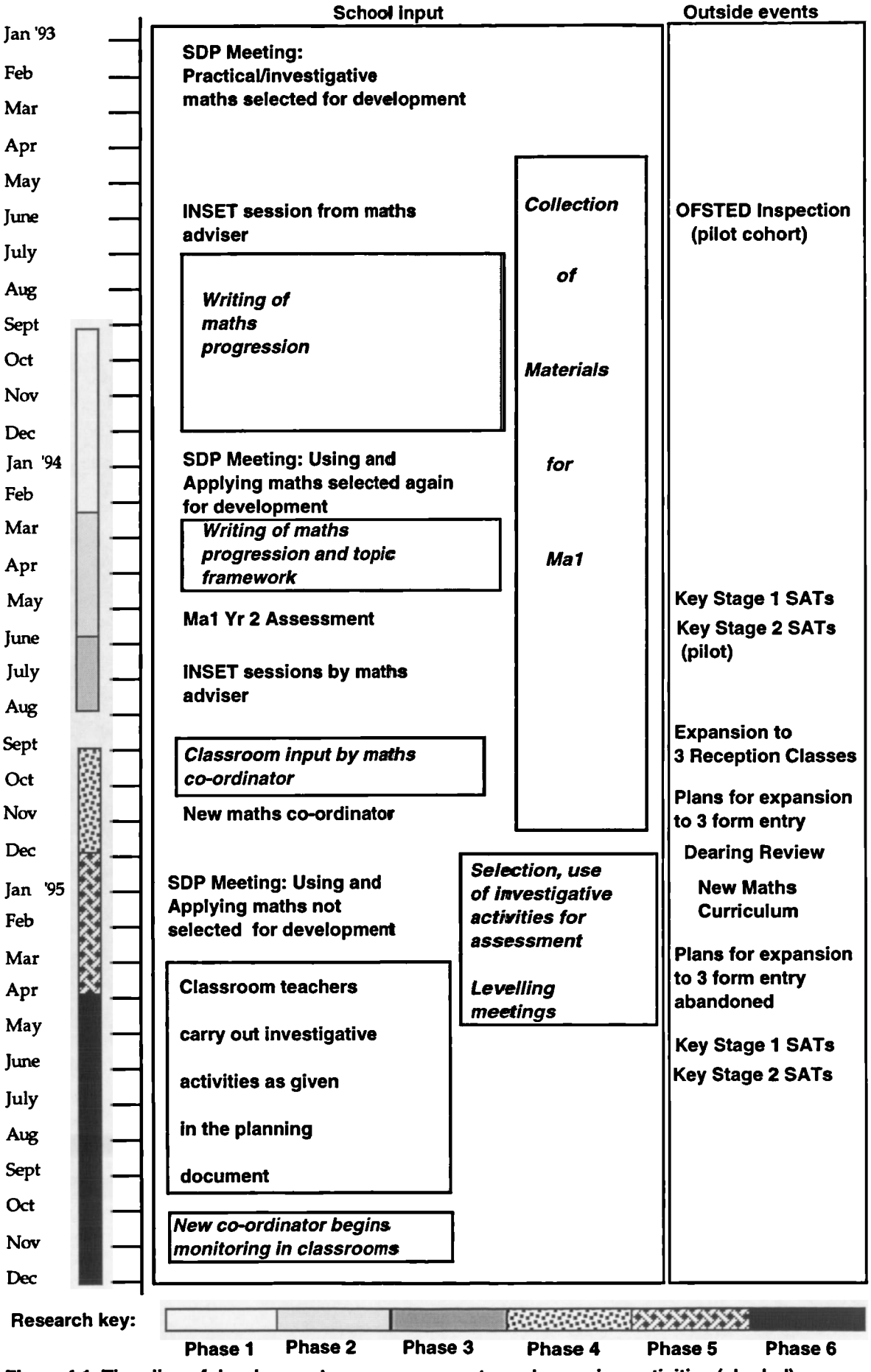

Figure 4.1 Time-line of development programme events and on-going activities (shaded)

Chapter 5. The whole school - "the way we do it here"

> For let no one be deceived, the important things that happen in schools result from the interaction of personalities. (Willard Waller, 1932, p. 1)

5.1 Introduction

Writers have searched for descriptors for the complex and changing nature of primary schools. Nias, Southworth and Yeomans (1989) have used the metaphor of the school as a mobile to illustrate shape, space and movement, providing a model for studying individual elements, groups of elements and the whole, as and when appropriate. The 'organic' metaphor introduced earlier in this work is intended as a metaphor for analysis, rather than for illustrating the changing and developing nature of a primary school. As this work has progressed over two years of fieldwork and beyond, I have found the model helpful. Within the 'whole', it has enabled the intervening layers and the 'heart' to be seen as, at one and the same time, having identities of their own, but yet being integral parts of the 'whole'.

In this chapter the focus is on the 'whole'. Greenside School has been introduced to the reader in Chapter 4 as I came to know it. The picture presented by the school was one of coherence, of 'wholeness'; the challenge to be pursued, one of understanding how this picture had developed, how secure it was, how it was regarded by those working within it, and how it related to the development of 'Using and Applying Mathematics'.

5.2 Culture and context - the literature

In terms of Fullan and Hargreaves' (1992a) four part model (the school culture and context, the teacher's purpose and the teacher as a person, see Chapter 2), this chapter deals with aspects of culture and, to a limited extent, that of context. It has not been part of this work to study contextual factors in any depth, particularly those of a local nature, although it is recognised that they play an important part in the development of the culture of a school and in its attitude to innovation. The focus of the work has been on the teachers, and although pupils are also part of the 'heart', working with teachers in the classroom, they have not been interviewed, nor have their parents. Contextual factors, both local and national, were noted in fieldnotes as and when they arose, and are discussed within the context of the school culture and how this related to individual teacher development.

My own experience of working in primary schools has guided the choice of literature in which to set this discussion of the whole-school culture at Greenside School. Within an initial model for data collection and analysis which included both individual and collective characteristics and responses to innovation, broad ideas of school culture which encompassed both individual and collective beliefs, values and norms and the interactions between them, were considered to be of greatest value to this work.

5.2.1 Components of culture

It is now over sixty years since Willard Waller (1932) drew attention to the nature of the school as a social organism, and to the interdependent nature of its parts. He saw the school as a "unity of interacting personalities" (p. 6) with a culture of its own that included beliefs, ceremonies, rituals and values - a complex picture of interrelationships. This complexity was also recognised by Sarason (1971), who cautioned against underestimating the complexity of the school system as a social system and pleaded for an admission of this lack of understanding.

> Culture and system are not concrete, tangible, visible things in the way individuals are. [...] It is only in recent years that we have become aware of how little we know about schools as functioning organisations or systems. (p. 228)

Sarason was of the opinion that lack of understanding came about partly through unwarranted assumptions of understanding by researchers, and simplistic categorisations of school characteristics.

Deal (1985) compared aspects of culture drawn from studies of effective businesses with those displayed by effective schools and found the following in common: "shared values and beliefs, well-known and widely celebrated heroes and heroines, well-attended and memorable rituals and ceremonies, positive stories and a dedicated informal group whose members work diligently to maintain and strengthen the culture" (p. 609). Stenhouse (1983) described culture as consisting of values, understandings and meanings. Implicit in this definition were ideas of consensus, of shared meanings. The culture of a group had to be "inferred from behaviour", he felt, and was not "explicit and externalised" (p. 23). Grimmett and Crehan (1992) described culture as 'constructed reality' (p. 58), consisting of the beliefs, values and norms which governed what was considered to be of worth, and the feelings, thoughts and behaviour of members of the group. This latter definition takes a symbolic interactionist stance and identifies those components of a school's culture which I would wish to take forward into this study.

A school's culture is determined in part by given ingredients ('background factors', Hopkins, 1994, p. 81) which may of course change over time - the context in which the school is set. The immediate environment, the pupils, the parents; the wider environment, the political atmosphere surrounding schools and teaching, are all 'given' at any moment in time. How the school works with and within this context ('organisational variables'. op.cit. p. 81) will depend on other ingredients; the quality and style of leadership, the ways in which beliefs and values are expressed and the degree to which these are shared, the feelings of all those involved towards each other and towards the school. All ingredients interact and affect one another. Each 'mix' is different from every other 'mix'. The culture of each school is unique, developed from and determined "by the influence of its buildings, organisational arrangements, the people who worked there, their histories and that of the school" (Nias, Campbell & Yeomans, 1989, p. 45).

The symbolic interactionist perspective does not permit the concept of culture as a static entity. Cultures are in a constant state of flux, dependent not only on fluctuations in context, but also on changes in the relative strengths and personalities of individuals and groups. "The way we do it here" (Nias et al, 1989, p. 15) will change from time to time, and is never the whole story; it may only provide a picture of the dominant culture. Perhaps 'the way we do it here at the moment' would better describe this feeling of movement and change.

Ideas of cultures emerging from conflict are illustrated by Waller (1932) and Handy (1988). Waller described the conflict between the differing cultures of teachers and students, with the former trying to impose their culture on the latter. Handy (1988) identified four different cultures which were likely to exist to different degrees and in different combinations in schools and described schools as being "pulled four ways by the demands of different cultures" (p. 116) and concluded that it was the task of management to "gather the cultural forces together, using the strengths of each in the right places" (p. 116).

The complexity of a school's culture will be only partly accessible to a short-term visitor; glimpses of its ethos will be acknowledged and interpreted. Sarason (1971) warned that the researcher must be constantly aware of having only a partial view, reflecting the position, standpoint and preconceptions of the observer. "The attempt to gain perspective on the structural characteristics of the school culture, particularly as they have a bearing on the processes and problems of change, runs headlong into the

problem that the observer is not neutral " (p. 15). But within these parameters, the effort must be made. Other aspects of culture are susceptible only to the researcher's efforts to 'get under the skin', to become sensitive to accepted ways of behaving and to try to understand the beliefs and values which underpin them.

Fullan & Hargreaves (1992b) drew on the work of Nias, Southworth and Yeomans (1989) to describe the characteristics of a particular type of culture (a culture of collaboration) as the "pervasive qualities, attitudes, and behaviours that run through staff relationships on a moment-by moment, day-by-day basis" (Fullan & Hargreaves, 1992b, p. 65), rather than the formal organisation, meetings or bureaucratic procedures. I would argue, however, that the latter can, to considerable extent, mirror or exemplify the former, and provide a useful focus of study in themselves. The chosen ways of organisation have implications about beliefs, attitudes and behaviours.

The way in which a school is managed is part of the face which it presents to the world. It is an important component of its culture and a public statement about it. Other parts of this face can be recognised from a school's brochure; from the style of its letters to parents; from the degree of welcome it gives to parents as participants and partners; from the overt quality of relationships between staff, and between staff and children. The management of Greenside School, and the feelings of different participants to the style of management, emerged at an early stage as an important constituent of the data, and subsequently in data analysis as an issue of considerable relevance to the mathematics development. For this reason a closer look will now be taken at different types of management practice and the implications behind them.

5.2.2 Theories of management

Educational institutions are not straightforward places to manage. Primary schools may be wrongly judged to be simple institutions in management terms because they are small (Southworth, 1987). Their objectives are complex to define and measurement of achievement of objectives is even more complex. The pupils possess infinite variety, and react in different ways to their experiences in school. They are also pursuing lives independent of school outside school hours. The professionals who work in education have to some extent common backgrounds in terms of education and training, but to a lesser extent possibly in beliefs and values. There is also little time for teachers to undertake the managerial aspects of their work. Success or failure in the classroom has always been the main criterion upon which teachers have been judged (Hargreaves,

1989) and while this still remains the case, teachers will give priority to the classroom aspect of their work.

Bush (1986) suggested five useful perspectives reflecting different ways of looking at educational institutions; formal, democratic, political, subjective and ambiguity models. In both formal and democratic models, the structures are regarded as objective realities, hierarchical in the former and lateral in the latter. Objectives, in the formal model, are set at institutional level, with goals determined by senior staff and the support of other teachers taken for granted, with the official leader having the key role in decision-making. In the democratic model, members agree on the goals, a complex process of discussion leading to consensus. The political model portrays structure as one of the unstable elements of an institution, which can lead to conflict within it, the goals of subunits being stressed in this case with their leaders being active participants in a process of bargaining and negotiation. In the subjective model, organisational structures are regarded as the product of the relationships of individuals, with individual goals being particularly important and the emphasis of the leader being given less emphasis; whereas the ambiguity model regards goals as being opaque, and both organisational structures and goals being problematic. "Ambiguity perspectives emphasise that there is fluid participation in the management of organisations. Members move in and out of decision-making situations" (Bush, 1986, p. 112).

The influence of organisational structures differs according to the perspective from which the institution is viewed. Bush (1986) quoted Clark (1983) who stressed the powerful influences of structures: "Academic structures do not simply move aside or let go: what is in place heavily conditions what will be" (Clark, 1983, p. 114). The symbolic interactionist standpoint which informs the subjective model of organisations was illustrated by Gray (1982) and presented a different view. "Structure is simply a description of what people do and how they relate; organisation structure is a grossly simplified description of jobs and relationships. [...] A structure cannot be imposed on an organisation, it can only derive from what people can do" (Gray, 1982, p. 34).

The validity of any one of these models for a particular organisation depended, in Bush's view, on five overlapping considerations: the size of the institution, the nature of the organisational structure, the amount of time participants have, the availability of resources, and the nature and rate of change in the environment.

There have been attempts to suggest a sequential link between these models (Davies & Morgan, 1983). However it seems to me that a sequential link is too restricted a model

if the considerations outlined by Bush are to be taken into account, particularly in view of his fifth condition, the nature and rate of change which has been provoked in education over the past few years. Schools have had to respond to requirements from outside which have necessitated changes in their management structures at a pace which has not allowed these to develop from identified goals within the organisations themselves. Ellstrom (1983) suggested that models of management should not be viewed as mutually exclusive and that:

> ... it might be possible to obtain a more comprehensive understanding of organisations by integrating the [...] models into an overarching framework. (Ellstrom, 1983, p. 236)

In some cases, increased demands on middle managers in schools (curriculum co-ordinators in the case of primary schools) and suggestions that policies and schemes of work should be the result of collaborative enterprise in schools if they are to meet the requirements of inspection, have combined to produce increased delegation from headteachers to middle managers, and from there to class teachers. In other cases, it is possible that the demands of accountability for implementing change have led to feelings of vulnerability in the leadership, and have resulted in more decisions being made at the centre.

The way in which schools are managed has been identified as one of the key factors in school effectiveness. Firm and purposeful leadership by the headteacher, the involvement of teachers in decision-making and some consistency of views among members of the institution were among the 11 factors identified as key characteristics of effective schools (Sammons, Hillman & Mortimore, 1995). This would suggest that elements from both the formal and democratic models suggested by Bush can contribute towards an effective school. Affective elements relating to individuals' feelings about the nature of their roles within a school draw also from the subjective model.

It is likely, then, that schools will draw from several models of management in establishing a style which suits the nature of current demands made upon the organisation, the resources it holds to meet those demands, the beliefs and values of the people working within the school. Original intentions in establishing a management style will necessarily be mediated through the responses of individuals and groups within the organisation. Flexibility within the organisation may lead to an on-going process of modification, reflecting the needs of the school.

5.2.3 Collegiality

The nature of the teachers' involvement and the freedom which they have to participate or not in whole-school collaboration have been the subject of considerable comment by researchers. Descriptions of 'collegiality' in school situations abound. Campbell and Southworth (1992) were reluctant to offer a precise definition, but suggested that it involved "staff working together in a school where the culture is cohesive and educational and social beliefs are shared" (p. 77). Becher & Kogan's (1980) definition of a collegiate model (in this case relating to higher education) made no claims about shared beliefs but focused more on ways of working.

> Collegium designates a structure or structures in which members have equal authority to participate in decisions which are binding on each of them. It usually implies that individuals have discretion to perform their main operations in their own way, subject only to minimal collegial controls. (p. 67)

Hargreaves (1992a) described two perspectives of collaborative cultures, contrasting the facilitation of consensus-building by a "largely benevolent and skilled educational management", with a micro-political perspective in which collegiality "results from the exercise of organisational power by control-conscious administrators" (p. 83). In distinguishing between collegiality and 'contrived collegiality' he included spontaneity as an essential feature of a collaborative culture (collegiality rather than contrived collegiality). Drawing on later work of Southworth, among others, he suggested that collaborative working relationships between colleagues were 'spontaneous', 'voluntary', 'development-orientated', 'pervasive across time and space' and 'unpredictable' (Hargreaves, 1992a, pp. 85/86). In contrast, features of contrived collegiality, according to Hargreaves, were that they were 'administratively regulated', 'compulsory', 'implementation-orientated', 'fixed in time and space' and 'predictable' (p. 86).

This bi-polar model, with its opposing and value-laden constructs, does not adequately encompass the complexity of school management as it exists today. I would suggest that the possibility of teachers being able to work developmentally, rather than implementally, in a spontaneous and voluntary way in the current situation is one which headteachers and teachers would dream about, but would not consider realistic, given the nature of recent demands and constraints on the education system.

In other recent writing, Fullan & Hargreaves have suggested a position of 'bounded' collaboration (Fullan & Hargreaves, 1992b, p. 74) situated between collegiality and contrived collegiality, where a collaborative culture exists but does not extend to classroom settings and hence can get stuck with "advice giving, trick-trading and

material sharing" (p. 75). Acker (1990) in her case-study of the response of two primary schools to National Curriculum innovations, suggested that, initially at any rate, responses could be placed in this category, rather than operating "in the world of ideas" (Fullan & Hargreaves, 1992b, p. 75) as 'extended' collaboration does. It is, however, quite possible that extended collaboration may be easier to achieve in some subject areas than others. Subject differences add another dimension to the intricacies of collaborative cultures in primary schools, and will be referred to again later in this chapter (Section 5.4.3).

Hargreaves (1992a) identified two of the major consequences of contrived collegiality as inflexibility and inefficiency; teachers not meeting when they should (i.e. when the needs arose) and meeting when there was no business to discuss. Part of the current role of leadership may well be to ensure that this does not take place by creating flexible management structures.

5.2.4 The role of the headteacher

David Reynolds (1994) suggested that the picture of effective school management that appeared in research might be dated. "... the effective headteacher of the 1990s has somehow to broker the external change agenda to his or her staff, a very different and much more complex task. "(p. 23).

A dominance-compliance model, advocated by some management experts, "does not fulfil the needs of the development of a collegial atmosphere" (Yeomans, 1987, p. 139). The realities of the present situation call for different management structures and a different form of collegiality, one which may require some contrivance in terms of administrative support and structure, but where this contrivance does not necessarily negate the value of the results of collaboration.

This increase in complexity in the role of the headteacher involves possible conflict between leadership and collegiality. Southworth (1987) concluded that the two were not necessarily compatible and the development and maintenance of both might lead to changes in the roles of both heads and other members of staff, with considerable implications for staff development. Leadership and membership are required by all members of a collegial primary school (Yeomans, 1987). Southworth drew on Eisner (1985) in support of his plea for a more thorough discussion of collegiality, regarding both leadership and collegiality as "invitations to enquiry", rather than as a "rhetoric of conclusion" (Southworth, 1987, p.72).

Ball's (1987) identification of one of the dilemmas of headship as being between participation and control reflects this possible conflict between leadership and collegiality. If collaboration is to result in, for example, effective curriculum development, the head must not only be the leader of a learning school (Nias, Southworth & Campbell, 1992), but must herself be the leading learner, a leading participant in the collaborative development (Southworth, 1994), able to influence colleagues by example.

> The prevailing view that heads and other leaders should be strong and purposeful needs to be set alongside the more recent view that they also need to be subtle; not in a manipulative sense, but in terms of being able to influence colleagues by asking questions, modelling a strong interest in teaching and learning and encouraging teacher reflection. (Southworth, 1994, p. 68)

Leading by example is just one of the professional (as distinguished from executive) roles of headteachers outlined by Coulson (1987), through which they seek to develop the culture in a school; selection of staff who appear to share their beliefs, values and aspirations is another (Nias, Southworth & Campbell, 1992). Some situations render this impossible, however, and headteachers must work with the staff currently in the school, promoting their values and influencing colleagues through convincing performances in both the executive and professional parts of their role.

5.3 School culture - Greenside School

In line with a stance which sees culture as 'constructed reality' (Grimmett & Crehan, 1992), no claims are made to be seeing or describing **the**, or **the only**, culture in Greenside School; rather the following represents my perceptions from the point of view of someone who spent, in total, many hours in the school, but who was, by definition, **not in the school** for a far greater number of hours. As described in Chapter 3, a review of the research was written for the school at the end of two years of fieldwork, which contained an abbreviated version of much of what follows in this thesis. My perceptions were thus in a position to be challenged by any of the members of staff, but this did not, in fact, happen.

The major sources of data on aspects of management at Greenside school were initial interviews and fieldnotes collected throughout the two years of the research (probably the richest source). Initial interviews were wide ranging and attitudes to management emerged spontaneously. School documents and the OFSTED report (OFSTED, 1993b) were also studied. Interviews were with individual teachers. Fieldnotes covered formal

meetings which I attended, either entirely or partially related to the mathematics development, and less formal conversations in the staffroom and around the school. (A selection of fieldnotes is given in Appendix 11 and of extracts from initial interviews in Appendix 6.) Fieldnotes and interviews were coded on aspects of management and affective factors relating to management. Sub-categories were then developed and this analysis can be found in Appendix 5b.

As stated at the beginning of this chapter, aspects of context, important though they were, have been part of this study only as they impinged directly on data collection relating to the mathematics development. National and local contextual factors were clearly affecting teachers' priorities in drawing up the school's development plans over several years (see Section 5.4.2) and thus became part of the data analysis. It is recognised that beliefs and values of children or parents have not been addressed, but within the constraints of resources, it was considered that a focus on the teachers was of prime importance to the research. This constraint also applied to other members of staff working in the school, classroom assistants, administrative staff, dinner ladies, and the caretaker.

5.3.1 Recent developments

The vignette of Greenside School (Chapter 4), introducing the reader to the school, described some of the aspects of the culture of the school which were readily apparent, noting a feeling of purpose, a coherence of attitudes towards adults and children, an indication of a set of agreed norms.

Greenside School had experienced a considerable change in staffing over the four years preceding the research. Laura, the Headteacher, was appointed for September 1990, and had in turn made several of her own appointments. The Deputy Head (Eric, DH) started at the school in January 1992, and at the beginning of the research only the Nursery teacher (Ruth, maths co-ordinator, MC, and early years co-ordinator), one Infant teacher (Diana) and four Junior teachers (Carol, Olwen, Mike and Ursula) pre-dated the Head.

A management structure had been developed and put into place over the three years from 1990 to 1993, and in September 1993 consisted of a Senior Management Team of Headteacher (Laura), Deputy Head (Eric) and curriculum and assessment co-ordinator (Mary, CC); a Management Team of Head, Deputy, curriculum co-ordinator, Junior co-ordinator (Liz, JC), Infant co-ordinator (Tessa, IC) and early years co-ordinator (Ruth,

MC), and a division of subject responsibilities among all staff who carried either a subject co-ordinating role, or a shadow co-ordinating role. In addition, all staff were members of at least one of the working groups which were set up yearly to address areas for review in the School Development Plan. Because of changes in the points allocation, the Head had been able to make her own appointments to both Senior Management and Management teams.

There was a regular pattern of meetings; full staff meetings were not held every week. In some cases they alternated with working group meetings and departmental meetings. Reporting back then took place at the following full meeting. Both management teams met regularly and reported back to full staff meetings. In addition to these timetabled meetings, individual members of staff met more informally with their year group colleagues to discuss planning at the classroom level, using the planning documents, both subject orientated and topic orientated, which had been developed through whole-staff activity.

Since 1992 the areas for review in the School Development Plan had been discussed during a staff Inset day in January before being presented to governors, with the involvement and participation of all staff, including classroom assistants and the bursar. The plan for this day was being refined yearly, each one being regarded as a learning experience to assist development in the following year. In 1994, governors were also invited (none in fact attended due to an oversight on dates by the governor who had intended to come). Before the meeting, teachers were asked to prioritise areas for development. At the meeting, year group teachers agreed on common priorities, and these were then discussed by the whole meeting, with those areas receiving the highest priority by most year groups going forward to comprise the foci of the School Development Plan. Finer decisions about aims and objectives in each area were then discussed by working groups, established on a voluntary basis to work throughout the school year. This selection was made by asking for volunteers; there was clearly some pressure on teachers to volunteer for one or more groups, but responses to that pressure varied from those who volunteered for one group and those who volunteered for three or more.

It was not easy to establish, from early visits to the school in September 1993, whether the apparent coherence in various aspects of the running of the school had been in existence before the arrival of the new Head, or whether she was, in effect, responsible for the creation of this aspect of the school's culture. From comments made by

members of staff, however, it became clear that she had made considerable changes in how the school was run.

> *I came at the same time (as the Head), so I've actually seen all the changes that have gone on in the school since the Head came, and it's quite remarkable, in fact quite unbelievable really, how much has been achieved in such a short space of time [...] We've come a long way.* (Tessa, IC, Int. 14, January, '94)

Another example was a remark made by the maths co-ordinator in interview:

> *Last year was the first time we did the School Development Plan that way. Prior to that, it had been more Head's and Deputy's decision with co-ordinators helping, it hadn't been everybody, so that has gradually grown ...* .(Ruth, MC, KI, Int. 9, January '94)

The Head was, however, not doing this on her own. The creation of the working groups had been the Deputy Head's idea, and had been introduced at his suggestion. The Head indicated that there had been some resistance from a few members of staff to her initial management reforms in terms of the co-ordinators' responsibilities and allowances, but that she was happier now with the structure that she had established, and the staff who were filling the roles.

Aspects of formal, democratic and subjective models of management (Bush, 1986) were evident in the way this school was run. Formal structures had been established and there were expectations of teachers to fulfil identified roles within this framework. The workings of the formal structures were, however, dependent on how all members of staff interpreted their roles and those of others. Flexibility was maintained by an attitude which regarded ways of working as learning experiences, open to change and revision. Staff were consulted on all major decisions and this consultation was real - priorities were arrived at through the exercise of negotiation. It could not, perhaps, be said that all teachers agreed with all decisions, but rather that majority decisions would be implemented. Southworth (1987) described the "idealised" collegial school as one which had: "small working groups of teachers feeding back suggestions for school-wide change to the collectivity of the whole staff meeting for decision-making" (p. 67). The presence of situations of conflict such as those described by Waller, (1932) and Handy (1988), between competing sub-groups or between teachers and pupils, was not noted in this research; there were criticisms voiced between Infant and Junior departments on occasion, but these appeared to be of a minor nature, and did not involve jockeying for position within the whole-school framework. The culture and context of secondary schooling is perhaps more likely to involve conflicts between interest groups. Some individual voices expressing dissatisfaction were, however, noted (see Section 5.3.7).

In Hargreaves' terms a culture containing these formal structures to initiate discussion and development would be termed one of 'contrived collegiality'. The meetings were, on the whole, neither spontaneous nor voluntary. An orientation towards development or implementation is not so easy to define, and can often seem to combine both - being concerned with developing the school's own curriculum within the context of implementing the National Curriculum. They were also to some extent fixed in time and place with predictable outcomes. However I would suggest that the way in which this school was managed also evidenced the values discussed by Campbell and Southworth (1992) as being part of a culture of collaboration: valuing individuals as people; valuing individuals for their contribution to others, valuing interdependence; valuing security and openness and accepting the role of the Head.

5.3.2 Valuing individuals as people

My first experience of the valuing of individuals within the school was at the stage when my use of the school for research was requested. There was a clear assumption that consultation of all members of staff was vital, and their approval of my presence in classrooms and at meetings was requested regularly during the course of the research as teachers left and others came new to the school.

The Head viewed the staff in a positive light (Fieldnotes 23, February, '94), and stressed their value as individuals. Support for individuals illustrated the value placed on their contribution, and could be seen in a variety of situations, whether in relieving a member of staff from a difficult child (Fieldnotes 12, November, '93) or in terms of staff development. Strenuous efforts were made to cater for attendance at co-ordinators' meetings and other Inset activities, and to make time to release teachers to talk to visiting advisers. Ruth, the maths co-ordinator, was released for a whole morning to talk to the maths adviser, and clearly valued this opportunity, describing it as a chance for her to *"talk freely with the adviser listening"* (Fieldnotes 24, February '94). The daily diary revealed that teachers were frequently out on courses (Fieldnotes 23, 26, February/March '94). Appraisal was taken seriously and teachers received training to appraise one another. The Head had a regular teaching commitment across the school, and, together with the Deputy, provided non-contact time for teachers. Newly qualified teachers were well supported by other teachers.

> *I'm supposed to be seeing Ruth about maths anyway, because I've mentioned it, and in my reviews with Eric (Deputy Head) I've said that's the sort of thing that I want more guidance on because I think I need it.* (Karen, Int. 6, December '93)

I mean, I find it very easy to talk to everyone here, so if I wasn't sure about something I would go and ask about it. (Una, Int. 23, November '94)

Personal as well as professional support was evident. Individual crises were dealt with sympathetically. Allowances were made, extra help was given so that teachers could, on occasion, go home early. Teachers seemed to be aware of stressful times for others and would remember to ask how things were. Concern was reciprocated from other members of staff towards the Headteacher (Fieldnotes 30, April '94). Liz (JC) had recognised the Head was looking tired early in the term, having had to come in during the holidays to supervise building work.

5.3.3 Valuing individuals for their contribution to others

There was considerable valuing of expertise, whether subject specific or organisational by one teacher of another (Fieldnotes 4, October '93). At a Junior maths meeting, where Ruth was presenting the maths progression for discussion, Olwen's first comment was *"I think this is marvellous"*; Liz, the Junior co-ordinator, concluded the meeting by expressing her appreciation of Ruth's work, and how useful it would be to all of them and this was reinforced by all the staff present (Fieldnotes 25, March '94). Mary, the curriculum co-ordinator was complimentary about the work done by different members of staff on the topic framework that they had been working on, and on the same subject the Head commented:

I feel they're doing a marvellous job on that [...] I mean, I've had nothing to do with this, they've all gone off, you know, Mary, Liz and Tessa have sort of initiated it, they've all gone off and they're all doing it. (Head, Int. 19, March '94)

This confidence in delegation indicated the value that she placed on the contributions of others.

Recognition was expressed openly. After the Data Handling Inset meeting for staff (Fieldnotes 45, October, '94) both Head and staff expressed their satisfaction with the content of the session, and how it had been handled by the IT co-ordinator (Meg, WG1/2). This Inset meeting was also an example of the Headteacher taking on the role of leading learner (Southworth, 1994), participating fully in this hands-on session, revealing inadequacies and seeking answers. Assemblies (a source of considerable anxiety to some teachers) were praised and the effort that had gone in to them, not just from teachers, but from ancillary staff and parents as well, was acknowledged.

5.3.4 Valuing interdependence - belonging to a group, working as a team

The Deputy Head, who initiated the idea of working groups in the school, was, not unnaturally, an enthusiast for working in this way. He felt that working in small groups gave teachers confidence to contribute more at whole staff meetings (Fieldnotes 19, January '94), which I had already noted in a full staff meeting which I had attended (Fieldnotes 14, January '94). He felt that it needed a particular sort of head to be able to devolve responsibility to the working groups, a head who did not see the school as 'her school'. As a head, you ran the risk working like this, he thought, of having to let go on decisions you were not necessarily in total agreement with, yet having to retain a head's responsibility for the final decisions made. Other teachers also expressed positive views about working together:

> (Nell, Int. 22, November '94, on coming new to the school and taking on the post of maths co-ordinator)
> *Yes, I think the way that they have the working parties is good, because you get the support of your other members of the group. I think that's a nice idea. [...] You can talk things out with them and bounce ideas off other people.*

Chapter 6 looks in greater depth at the work of the groups relating to mathematics and the role of the co-ordinator.

Other teachers appeared to relish involvement in co-ordination and management in the school. Tessa was really enjoying her role as Infant co-ordinator: *"I think I like to get my hands on to things and become fully involved"* (Int. 14, January '94). Mary, a key informant who held the position of curriculum and assessment co-ordinator, took her role extremely seriously and appeared to respond positively to the demands made on her.

> *Being assessment co-ordinator people are going to come to me and say, "so how do we do this?" And I said to the Head that I didn't feel that I was doing that anywhere near properly at the moment, but I think before I did that I would have to get the planning and the use of it really structured in the classroom, so that I really knew beforehand what I was expecting to get out of it.* (Mary, CC, KI, Int. 12, January '94)

The acceptance by other members of staff of the authority and expertise of others was noted early on during the research and recorded in fieldnotes. This matter-of-fact acceptance made meetings more purposeful. Time was not wasted in chat, expertise was shared, advice was given and taken.

> There were some definite undercurrents which were dealt with firmly, but in a friendly way. For example, one of the Year 1 teachers, Linda, was obviously suggesting coverage that the others thought should be tackled in Year 2, and there were some firm reminders about the importance of practical work from Ruth (MC) and Tessa (IC). [...] There were one or two other items on the agenda which were dealt with swiftly. I was struck again by the efficiency of the management, and the acceptance of this by other members of staff. There was no extraneous chat; if there was any sign of drifting off course, Tessa would being the subject firmly back to the matter in hand. (Fieldnotes 4, October '93)

Ruth, the maths co-ordinator and a key informant, said during an informal conversation that everyone accepted that frequent meetings were necessary. A definite structure was needed. These meetings were timetabled well in advance and were at regular times, so everyone knew where they were, she said (Fieldnotes 7, October '93).

Teachers at Greenside also expressed satisfaction with working together in less formal ways.

> *It's really nice here because there's lots of younger people here than my last school, and I get on really well with Olivia now, and maths, share ideas, she's really enthusiastic about maths.* (Nell, new MC, Int. 22, November '94)

Examples of teachers planning together were frequent, and a combination of professional and social talk could be observed at lunchtimes (Fieldnotes 47, November '94). At times there were signs of the common division between Infant and Junior departments, but these were more apparent at formal meetings than in informal situations. A Year 4 and a Reception teacher often chatted over lunch in a classroom. Strong social groupings formed and dissipated as changes in staff affected the balance. Mary (CC, KI) and Liz (JC), frequent users of the staffroom, generated much conversation and laughter and seemed to initiate after-school contact with several teachers and their partners, yet a clique did not appear to be forming, and conversations were open to all. Although there were frequent discussions between year group pairs of teachers, exclusive conversations (of a professional or a social nature) were not carried on (Fieldnotes 23, February '94). Classroom assistants used the staffroom freely, and parents came in and out to make coffee. Visitors (and researchers) were not left to sit in silence in the staffroom. Ruth's return after maternity leave in July 1995 had a noticeable affect on the staffroom.

> Ruth was back and seemed to provide a spark of added humour in the staffroom. Conversation was fast and furious, and she was having a very positive conversation with Nell, the new maths co-ordinator, about the next steps in the maths document. (Fieldnotes 64, July '95)

There was little 'griping' about school matters and on one occasion I noted it being disapproved of (Fieldnotes 11, November '93).

> Lesley, who I was to interview in the afternoon during her non-contact time, lost her free time because of another member of staff going home. She was quite outspoken about the injustice of this, only just managing to cloak her irritation with humour, comments which were not popular with other members of staff.

The size and shape of the school (as described in the vignette, Chapter 4) meant that communication was not easy. It was a long walk from one end of the school to the other, and the distance must have inhibited frequent brief visits to the staffroom or to other classrooms. Nias, Southworth & Yeomans (1989) commented on the effects which the physical environment could have:

> Buildings could create natural meeting places and 'critical pathways' ... . But buildings, especially temporary ones, could also reduce opportunities for interaction. (p. 33)

The staffroom at Greenside School was a difficult shape for social and professional interaction, and although mainly kept tidy and clear of the inevitable washing up, was not really very inviting. The Headteacher was, on different occasions during the research, anxious that teachers were not engaging enough socially with each other. She felt that this was detrimental to communication, and had, on one occasion, tackled this problem by reducing the number of timetabled meetings, thereby reducing time pressures on teachers.

> She had noticed (and I said I had noticed this too) that teachers were spending less time in the staffroom, and that this was not a good thing, as it made communication so much more difficult. [...] We talked briefly about how busy everyone was, and she said that she had realised at the end of the Summer term that teachers were really overloaded with meetings. She had lessened the meetings load this term, with fewer full staff meetings timetabled. She hoped this would help, even though it meant that full meetings had to go on rather longer. (Fieldnotes 49, November '94)

The Headteacher clearly felt that communication had to be worked at, and was willing to be flexible when she noted problems.

Sometimes the informal was less positive. As in any social group, there were times when relationships seemed irritable or restricted. Teachers talked more often in year-group pairs, rather than as a group. Teachers grumbled at the beginning of the school year in 1994 about the children who had come up to their class from someone else, and

this was noted in fieldnotes as an unusually negative conversation - not a frequent occurrence (Fieldnotes 41, September '94). Special occasions were marked with whole-staff get-togethers both in and out of school, but these did not necessarily encourage social relationships between teachers who did not normally chat together. On one occasion I wrote in fieldnotes:

> It was noticeable that most members of staff talked in the same year-group pairs in which they generally conversed in the staffroom, even though this was a social occasion. This was commented upon by Carolyn and Mary, saying it had been the same at the staff party the Friday evening before! (Fieldnotes 38, July '94)

5.3.5 Valuing security and openness

Openness is difficult in an environment which is not secure. If teachers are to be free to admit to failures as well as to be given credit for successes, they must be sure that these admissions of failure will not lead to adverse repercussions. The creation of such an open culture seemed to be a conscious priority of the Head

> A: *Do you think it's important that people should be able to say openly that they're still having difficulties?*
>
> Head: *Very much so, yes. I mean, one likes to think that that's the environment one's created, in that, yes, in that I hope they realise that ...that they've always got the chance to change things.* (Headteacher, Int. 19, March '94)

The existence of such an atmosphere was illustrated at the Inset Day to discuss the School Development Plan in January 1994 (Fieldnotes 14, January '94). On this occasion, teachers felt able to admit that they still did not feel that they really understood the implications of Ma1, and how to implement it, after a year of attempted development. These admissions inevitably led to feelings of frustration and failure on the part of the maths co-ordinator and the other member of the working group, but there was no suggestion that teachers should not be free to voice their views, even if it made others uncomfortable.

However, there were some situations in which openness was not so apparent. At the Inset Day to discuss the SDP a year later (January, 1995) there seemed to be a greater degree of unease about voicing opinions (Fieldnotes 51, January '95). In the interviews, some teachers were reluctant to voice dissatisfaction with the commercial scheme used in the school, anxious that their comments were being tape-recorded.

Another aspect of security emerged through the coding of fieldnotes - the security of efficient administrative back-up. The administrative support for the teachers appeared to be extremely strong. There was a general confidence in the knowledge and capability of the administrators, a confidence that things would run smoothly. Appointments were made and kept, and if there were misunderstandings, they were noted and acted upon (Fieldnotes 11, November '93).

It is possible, also, that the clear structure of working groups of different sizes and for different purposes gave these teachers a sense of security, a sense of knowing what the expectations of them were within the school, although there is no specific data to illustrate this supposition.

Another incident, recorded in fieldnotes, illustrated how this school dealt with a difficult situation, an accident to a pupil on school premises, in which openness of discussion enabled teachers and Headteacher to express feelings openly and admit to considerable anxiety. Because talk was not curtailed, strategies were put in place to ensure that the situation did not arise again, giving some feeling of security that positive action had been taken. The meeting ended with teachers talking together in groups, trying to come to terms with the situation (Fieldnotes 15, January '94).

5.3.6 Acceptance of the authority of the head

The Headteacher generally adopted a low profile at staff meetings, and delegated to the appropriate members of staff. From various comments that she has made in interview she believed in allowing staff to come to decisions without her intervention.

> Head: *I mean I deliberately don't go to Departmental meetings, ... in case people feel reticent and won't say things in front of me, so basically I won't go there. ... so I think there are times when you have to let people get on with it ...*
> (Headteacher, Int. 19, March '94)

There were, however, no indications from the data that the teachers felt overborne by the Headteacher in this way.

On other occasions she indicated that she waited for decisions from staff. She had felt that the title for the maths development of 'practical and investigational' maths, which had apparently been suggested by her, was too restrictive, and was therefore pleased at the amendment of this to 'using and applying mathematics' the subsequent year:

> A: *And what was your reaction to the change, well slight change of approach for the next year's development plan?*

Head: *Oh I think that's great, because I think that's really ... I've said to you in the past, I feel I've been at fault in that giving that pro-forma out to people to look at staff development, I had just 'practical and investigative' maths, and I think that in itself was restricting..* (Headteacher, Int. 19, March '94)

Sometimes she made her feelings clear about things which she felt really needed saying, and made quick decisions about things which she regards as a priority, for example giving the go-ahead for the visits of the maths adviser (Fieldnotes 18, January '94).

There seemed to be a general acceptance of her authority. Teachers referred certain decisions to her as a matter of course, but did not appear to find her unapproachable or difficult to ask. She went easily in and out of the staffroom, without perceptible restriction in staffroom conversation. Her regular teaching commitments meant that she kept in close touch with both teachers and pupils, and up-to-date with problems that might be developing, or needs which had to be met. When in her room, her door was often open, her desk placed so that she was visible to those passing by.

5.3.7 Opposing voices

In describing her arrival at the school, the Headteacher had hinted that some longer established members of staff had found it difficult to come to terms with a more collaborative way of working, finding the structure of frequent meetings and devolved responsibilities onerous.

Certain occasions arose, during data collection, when negative feelings about how the school was run were apparent, but these were very few. Expressions of discontent derived mainly from the demands of meetings on teachers' time (Fieldnotes 31 and 32, April '94), leaving little time for teachers to work in their own classrooms. These comments were made by the same teachers who had, in interview, expressed concern about the lack of time that teachers had to focus on their own classrooms, comments which were, to some extent, directed towards the more general demands of the National Curriculum.

Carol appeared in the staffroom, even though this was not one of her days to be working and Ursula commented on this, saying *"Carol's had to come in again. It makes you wonder about this part-time thing"*. (Fieldnotes 32, April '94)

It may have been the case that teachers were not prepared to make negative comments in front of me, but it is unlikely that I could have avoided hearing them, if they were

frequent. The appraisal system was established in the school, and it is possible that this was a channel used to provide a forum for the expression of negative views.

5.4 Collaborating on the development of mathematics

5.4.1 Ideas of 'merit' and 'worth'

The call for a change in the mathematics curriculum to include a requirement for teachers to incorporate process skills in their mathematics teaching could not, in 1989 when the National Curriculum was introduced, be said to stem from the primary classroom teacher. The mathematics education community had been recommending such a change for several years (see Chapter 1) and a small number of teachers, particularly at secondary level were also committed to reform, but a groundswell of dissatisfaction with the mathematics curriculum was not emerging from the primary arena.

The mandatory nature of the attainment target complicated the issue for most primary teachers. The need became one of 'delivery' of the curriculum stemming from a deficit feeling of not yet implementing the whole mathematics curriculum, rather than from a positive feeling of desire for change. The decision to promote development in the area of 'practical/investigational maths' at Greenside School was taken before I started work in the school, but initial discussion with the Headteacher and Ruth, the mathematics co-ordinator, indicated a combination of these two feelings in the school; a need for development that stemmed from a deficit model of implementation of Ma1, and one that stemmed from a belief in the intrinsic merit of the innovation itself.

From information gathered from the Headteacher and maths co-ordinator at the stage of selection of schools, the teaching of mathematics at Greenside School did not present a coherent picture (see Chapter 4). There was concern about variations in practice, including variations in, and over-use of, the commercial mathematics scheme. The decision made in 1993 to prepare a new mathematics curriculum document was partly in response to the need felt for a more unified approach throughout the school, and partly to better incorporate the implementation of Attainment Target 1 (Ma1, 'Using and Applying Mathematics') throughout the mathematics curriculum. The decision to promote the development of this part of the mathematics curriculum was arrived at through whole-school prioritising of needs to be focused on in the School Development Plan for the year 1993-94. However, it was not clear what attempts had been made to evaluate the innovation prior to this decision.

Guba and Lincoln (1985) used the terms 'merit' and 'worth' (pp. 39/40) to distinguish between some measure of the intrinsic value of an initiative, and a measure of value in terms of outcomes. Askew (Askew et al., 1993) adapted these terms in discussing perceptions of the implementation and integration of Ma1 which were identified during the Evaluation Project, as follows:

> Merit is the value a teacher attaches to Ma1 with respect to how well it fits with his or her beliefs about mathematics, teaching and learning.
> Worth is a measure of the value a teacher perceives as attached to Ma1 by others: colleagues, parents, pupils. (p. 198)

It is noticeable that these ideas of merit and worth refer to the interpretations of individual teachers. An agreement to prioritise Ma1 for development could imply some sort of consensus on the part of this group of teachers about the relative merit and worth of this innovation introduced as a mandatory part of the mathematics National Curriculum. However, as the following descriptions of whole-school meetings relating to the mathematics development indicate, these ideas were rarely made explicit. The reasons for this are complex. Nias, Southworth & Campbell (1992) pointed to tensions inherent in whole-school curriculum development (p.240), contrasting the collective nature of the former (the whole-school component) with the individual nature of the latter. These tensions, together with the security of ideas of consensus and issues to do with the nature of the innovation itself, were the subject of further investigation during the course of the work.

5.4.2 Whole-school meetings relating to mathematics

The mathematics development was promoted through delegation at three levels - whole-school, groups (led by the mathematics co-ordinator) and individual teachers. The organisational structures developed at Greenside School, devolving responsibility to departmental and focused working groups, indicated an acknowledgement that whole-school discussions could be unproductive, especially in a school of that size. Comments from both the Headteacher (about leaving teachers to get on with things without her intervention, Int. 19, March '94) and the Deputy Head (about the value of working groups, Fieldnotes 19, January '94) showed an appreciation of the fact that smaller groups facilitated discussion and provided more secure conditions for all teachers to contribute.

The whole-school meetings relating to mathematics which I attended during the course of the research were concerned with setting priorities for whole-school development;

with reviewing the work of the departmental and working groups, and, on one occasion, with a discussion of the mathematics Inset activities carried out by the mathematics adviser.

Eric, the Deputy Head, made several contributions in the SDP (School Development Plan) meeting in January '94, which may well have followed from his conviction that teachers found it difficult to contribute at whole-school meetings.

> He seemed to be voicing anxieties in general terms so that staff could identify with these, but not necessarily make the points on their own (Fieldnotes 14, January '94).

Eric made a series of comments about practical and investigational mathematics:

> *People still feel uncomfortable with this .* [...] *Nobody has really actually told us what they were.* [...] *People feel uneasy, because the situation is unstructured, and they feel they're losing control. Can they organise in a different way?* (Fieldnotes 14, January '94)

Conditions of openness enabled views to be expressed, but after that, discussion was limited. The exchange of views at this meeting which led to the retention of 'Using and Applying Mathematics' as a focus for development, although positive in nature with comments from several teachers being taken seriously, remained just that - an exchange of views. The over-riding feeling was one of uncertainty about 'what to do' or 'how to do it'. Issues of 'merit', in terms of the value of the innovation itself, or 'worth', in terms of value to colleagues, parents or children were not addressed.

Between this meeting and the following one in January 1995, there was a series of whole-staff meetings in which group leaders reported back on the work of departmental or focused working groups, mathematics therefore being only part of the proceedings. In the main, these dealt either with progress in attaining the objectives set for development (and in the case of the mathematics development, frequently focused on resources (see also Chapter 6)) or with the complex issues of whole-school curriculum planning and the relationship of individual subject progressions within topic framework that was being developed. The Inset meeting led by Eva Farley, the local authority mathematics adviser, in June 1994, again raised issues rather than really discussing them. My notes on this meeting (validated by the adviser) referred to strategies used by the adviser to get teachers talking:

> She waited, when asked a direct question, for any responses from other teachers. ... She did not take up discussion on contentious points (Notes on Inset Meeting, June '94).

Comments from the adviser indicated that she did not regard this whole staff meeting as an appropriate forum for addressing beliefs and understanding in any depth, but rather as an opportunity to make points which could be taken up and reflected upon later.

At the School Development Plan Meeting in January 1995, intervening contextual factors could be seen to be affecting the prioritising process. The Dearing review of the curriculum would clearly involve teachers in major changes to curriculum planning; the Local Education Authority plan to expand the school to three form entry (later abandoned) had serious implications for the organisation and management of resources and indeed for the whole school culture. The atmosphere at this meeting was considerably less positive than a year previously. Attention was focused on more organisational and classroom-based matters of resources, storage, health and safety.

> I felt no antagonism in the meeting towards the Head or senior management - rather a feeling of retreating into the safety of first aid courses and ordering stock, rather than the more demanding areas of teaching and learning (Fieldnotes 51, January '95).

Anxieties simmered, but were not voiced openly.

> *I'm worried that we're not doing any subjects.*
> *Shall we say it?*
> *Too late now.*

And later (also sotto voce):

> *I'm still surprised there are no subjects*
> *I think they'll be done to death with the post-Dearing. Also, we've done all the subjects, what more can we do?*

The decision taken at this meeting not to carry the development of 'Using and Applying Mathematics' forward to the next year's plan, came as the result of the joint prioritising exercise which had, in the two previous years, resulted in its inclusion. Those with the most positive views of the intrinsic 'merit' of 'Using and Applying Mathematics' were those who continued to give it high priority but they did not, on this occasion, carry the day.

5.4.3 Mathematics as a critical case

Greenside School's formal structures and less formal ways of working were intended to support development in all the areas of need identified, not just in mathematics. The

work of the school went on through the structures (meetings at various levels, individual contacts) and in the collaborative atmosphere described earlier in this chapter. Having worked with the National Curriculum for four years (with the second version of some subject documents), the school had established a need for more clearly defined and centralised planning for the whole school, with input from individual subject areas.

The decision had been made that subject co-ordinators should draw up progressions of work across the full age-range, and these were then, through discussion, developed into planning documents appropriate to each year group. Ruth, the maths co-ordinator at the beginning of the research, was not alone in having to undertake this task. Other subject areas, for example aspects of English, science and IT were also identified as in need of development, as were other areas of school life such as behaviour expectations and success in the classroom, and these were also included as the focus for development on the 1993-94 School Development Plan. The mathematics development did, however, have added support in that the Headteacher had previously been a mathematics co-ordinator herself, and was particularly interested in this development, being persuasive in arguing for the benefits likely to accrue to the school from being involved in the research.

It was my impression, though data to support this was limited by my attendance at meetings which discussed only mathematics in specific terms, that a greater air of uncertainty hung over the mathematics focus for development, than over other subject areas.

> There was more discussion about the maths sections [of the SDP] than about anything else. Ruth shows considerable lack of confidence in these meetings, and did not pursue her need to work with other teachers, which she had mentioned to me earlier on. It was questioned as to how the co-ordinator would evaluate the effectiveness of Inset organised, but this did not seem to be resolved. The confidence of children in using and applying their mathematics was added as a criterion for success, in addition to increased confidence of staff. I felt that the Head was less satisfied with this part of the SDP than with others. (Fieldnotes 16, January '94)

'Extended' collaboration (Fullan & Hargreaves, 1992b, p. 74) may be easier to achieve in some subjects than others. It is quite possible that in some subject areas, development is restricted to "advice giving, trick-trading and material sharing", rather than existing "in the world of ideas" (p. 75), for subject-specific, rather than school-

specific reasons. If curriculum development is to progress it must address the world of ideas, and, in doing this, must engage with both the beliefs and the practice of the individuals involved. The complexity of engaging with a range of interpretations of Ma1, the mathematics attainment target (described in Chapter 1), makes this area a particularly appropriate focus, a critical case for investigating teacher development in one area of the primary curriculum, within the context of a collaborative culture such as that developing in Greenside School.

5.5 Conclusion

Chapter 5 has presented a picture of the 'whole school' as I perceived it - its organisational structures, its ways of working with and within these structures, the style of leadership, the feelings of those involved towards working together. This picture did not remain static, it changed over the time of the research as teachers came and went, and as outside contextual influences impinged to a greater or lesser extent upon it.

The school presented a coherent face to the world and there was evidence that its unique set of beliefs, values, norms, and the ways in which these were expressed in formal structures of management and in less formal attitudes and ways of working exemplified, to a considerable extent, a collaborative culture. Teachers were valued both professionally and personally for their contributions to whole-school efforts and to other individuals. Openness was encouraged and a secure atmosphere provided. The authority of the Headteacher was accepted; the expertise of colleagues was respected.

Collaborative cultures do not require agreement and consensus on all aspects of school life, although broad agreement on educational values would be part of such a culture. "[T]hey also tolerate disagreement, and to some extent actively encourage it within those limits" (Hargreaves, 1992b, p. 226). The existence of tensions between individual and collective beliefs, views and priorities has been suggested in this chapter. It has also been suggested that, in the area of mathematics identified as requiring development in the school, uncertainty led to a initial reluctance to address these tensions.

The forum of whole-school meetings was not necessarily the appropriate one for revealing or encouraging agreements or disagreements, nor would members of Greenside staff necessarily consider that it should be. Indeed, beliefs and values held by members of this staff about the size and composition of groups most likely to facilitate tasks of different types and complexities had led to the structures of departmental and working groups which existed in the school. The role of the

mathematics co-ordinator, as a group leader working with departmental and working groups forms the subject of the next chapter.

Chapter 6. One layer down - the management of mathematics at Greenside School

6.1 Introduction

In the introduction to this thesis the metaphor of 'peeling back the layers' was used to describe the process of getting to know an institution, revealing the individual within the collective. Chapter 5 focused on the whole school: the culture it had built up and sought to maintain; the structures, strategies and relationships it had established towards this end, and, to a limited extent, the context in which the school functioned In this chapter the focus is on groups of teachers within the school, working to develop the mathematics curriculum in co-operation with the mathematics co-ordinator. The co-ordinating role and the expectations of those who take on the role and its accompanying strains and tensions is examined through reference to the literature. The role of the mathematics co-ordinator at Greenside School is then considered within that framework.

6.2 The role of the mathematics co-ordinator - the literature

6.2.1 Expectations

The increased professional demands made upon teachers in recent years are clearly exemplified in the role of the subject co-ordinator (or postholder). In 1956 professional responsibility was recognised by a 'responsibility allowance', a scale 2 or scale 3 post. In general, these posts were restricted to a few experienced teachers in a school and were not necessarily associated with curriculum leadership. With the salary restructuring of 1971, schools were allocated scale points related to numbers on roll; the process of allocation of these points according to the identified needs of the school and the identified strengths of the individual teacher led to the gradual development of the role of the subject co-ordinator, the curriculum leader (Stow with Foxman, 1988).

Expectations of subject co-ordinators increased, job-specifications grew in length and complexity, subject expertise was required. Primary Education in England (DES, 1978) noted that it was "disappointing to find that the great majority of teachers with posts of special responsibility have little influence at present on the work of other teachers'"(§ 8.45). This document then proceeded to outline a formidable list of duties for the mathematics co-ordinator which included: drawing up a scheme of work; giving guidance and support to other members of staff; assisting in teaching mathematics to

other classes when necessary; taking responsibility for resources, and the development of a monitoring system to assess the effectiveness of the guidance given and resources provided (DES, 1978, § 8.46). Harling (1981) called for schools to ensure that the role of the co-ordinator had been carefully analysed and defined to match the requirements of the particular situation in each school. The Cockcroft Report (Cockcroft, 1982) developed the role of the mathematics co-ordinator into a management role, extending the list of duties suggested by the DES in 1978 to include monitoring work in mathematics throughout the school; diagnosing and remediating learning difficulties; arranging appropriate school-based Inservice training, and liaising with other schools and the local education authority (Cockcroft, 1982 § 355).

Campbell (1987) described the postholder's role as moving "from a position of marginality in the curriculum, to one of centrality" (Campbell, 1987, p. 54). He saw the enlargement of the postholder role as having been encouraged by central authorities as part of the shift towards school-based curriculum development. He referred to Hargreaves' (Hargreaves, 1980) more cynical view of seeing this role prescription as providing a kind of surrogate promotion for postholders in a period of educational contraction.

Since the introduction of the National Curriculum in 1989 there has been renewed emphasis on collaborative planning as part of the process of its implementation. Evidence of the real involvement of members of staff in the preparation and revision of curriculum documents is considered during inspection by the Office for Standards in Education (OFSTED). The National Curriculum brought with it the need for schools to cope with increased subject content and accompanying increased subject anxiety. With the enlargement of some subjects which had in the past been regarded as fairly peripheral in the primary, and particularly the Infant school, it became common to find that all teachers in a school held a subject responsibility, with the more senior teachers holding wider curriculum and assessment roles in addition to subject roles. Financial recognition now does not necessarily follow subject responsibility. More and more teachers are required to provide subject expertise. Osborn & Black (1994) reported that 91% of the key stage 2 teachers in their study (commissioned by NASUWT) had responsibility for an area of curriculum development and 12% of these were also deputy heads - in their words "a formidable level of responsibility. In most schools, it seemed that the only teachers excluded from such responsibilities were probationers in their first year of teaching" (Osborn & Black, 1994, p. 26).

Not all schools have made the same demands of their curriculum co-ordinators. A job description containing all the requirements outlined by Cockcroft has not necessarily been handed to every in-coming curriculum co-ordinator. Osborn & Black (1994) found four levels of increasing demand in the co-ordinating role:

- resource gatekeeper;
- planning and resource facilitator;
- subject consultant;
- 'critical friend' - working alongside other teachers in the classroom. (p. 27)

These fairly self-explanatory titles included some form of curriculum development in all except the first, rather limited, level of activity (but which was nevertheless identified by 30% of their sample as describing their role). Teachers in the latter three categories might be responsible for schemes of work and policy documents, including the implementation of a commercial scheme, if the school used one. Only those in the 'critical friend' category were able to participate in working alongside colleagues in the classroom, gaining the oversight which might make a monitoring role possible.

Campbell (1987) summarised activities expected of curriculum postholders in a broadly two-fold classification: curricular skills and interpersonal skills. The former included knowledge of the subject, professional skills (eg. drawing up and managing a programme of work) and professional judgement (eg. knowing about various materials, approaches in the subject, relating these to the needs of pupils). The latter focused on working with, and teaching alongside, colleagues, and representing the school to others. Expectations of postholders or curriculum co-ordinators may be high, but the expectations do not necessarily carry with them the resources and the support to carry out the post effectively: nor have the tensions associated with the role always been recognised.

6.2.2 Tensions within the role

6.2.2.1 Lack of subject knowledge

A lack of subject knowledge in mathematics was recognised as a problem by Her Majesty's Inspectorate (HMI) particularly for primary teachers already in post (HMI, 1979).

> In spite of the great efforts which have been made over recent years, it is still the case that too many teachers have to teach mathematics without knowing enough about the subject, or about current ideas of teaching. (p. 11)

Based on the situation current in 1982, the Cockcroft Report (1982) described the need to:

> ... increase the mathematical expertise of teachers overall; and also to increase the number of teachers who take mathematics as a main subject during initial training or who, at a later stage, undertake a substantial course of in-service training in mathematics, so that there will be a sufficient supply of teachers who are able to provide leadership and help for their colleagues .(§620)

More than ten years later, reporting in 1993, OFSTED noted that

> Few schools had teachers who had studied mathematics beyond the minimum professional requirement of their initial training qualifications. While a significant number had gained mathematical qualifications during their teaching careers and some had benefited from GEST-funded 20-day courses, most were still not confident mathematically.(OFSTED, 1993a, p. 28-29)

OFSTED (1993a) described the quality of leadership in mathematics as a "highly significant factor in good curriculum planning and in achieving consistently good standards throughout a school." (p. 29). Discussing effective mathematics co-ordinators, they pointed to the benefits of attendance at 20-day courses, the provision of non-teaching time and the lack of other major curricular responsibilities as factors contributing to this effectiveness. Again, in 1994, OFSTED noted the benefit that would be seen "if teachers' confidence in their own mathematical competence could be improved" (OFSTED, 1994, p. 22). The beneficial effect of 20-day courses and advisory teachers was being jeopardised, it was felt, by contraction in the Local Education Authority (LEA) advisory service.

Even among those who had chosen to specialise in mathematics in their teaching training, problems were still evident in terms of subject-matter knowledge. Carré & Ernest (1993) found that of a sample of PGCE students specialising in mathematics, most "showed only a basic understanding of the topics likely to be taught by them in primary school" (Carré & Ernest, 1993, p. 50).

The need for curriculum leadership in mathematics had been noted, but in primary teaching the pool of teachers with a mathematics qualification above 'O' Level or GCSE from whom a maths co-ordinator would be likely to be drawn is still small. Research from the Evaluation Project (Askew et al 1993) indicated that, in 1991, of the teachers who reported some qualification in mathematics at A Level or above, only 16% were teaching at KS2 (Junior) and 12% teaching at KS1. Stow (1988) in her survey sample of 1681 mathematics co-ordinators, found that 24% had studied mathematics as one of their main or subsidiary subjects in their initial professional teaching courses. However, these co-ordinators were more likely to be teaching in Junior or Middle

schools, rather than Infant or First schools (the percentage for Infant schools was 18%). Inset was needed, both in terms of mathematics subject knowledge and in terms of the management skills needed for the developed role. Stow (1988) found that 40% of the co-ordinators in her sample had received no Inset specific to that role.

6.2.2.2 Teacher as 'educationalist'

Activities which place a co-ordinator in any form of consulting or monitoring role have their accompanying tensions; these are not only post-national curriculum conflicts. Campbell (1985) described the role of 'teacher as educationalist' as one "suffused with uncertainty, not because postholders themselves were necessarily uncertain, but because the activity itself was an ambiguous exercise" (Campbell, 1985, p. 68). Campbell pointed to a mismatch between the formal status of post-holders as curriculum developers, and their actual power as perceived by themselves and their colleagues. A postholder cannot 'make' other teachers adopt a new scheme of work, for example, or a change in practice. "Faced with passive resistance to innovation, the postholder was impotent." (Campbell, 1985, p. 72) The practice of working collaboratively with colleagues on curriculum development, although advocated on educational grounds, might in fact be an attempt to ensure implementation, suggested Campbell. Those involved in the preparation of an innovation have less legitimate cause to reject it.

The process of running working groups or staff workshops places the co-ordinator under the scrutiny of colleagues, with their knowledge of mathematics, organisational ability and familiarity with broader issues of educational theory and research all being the subject of this scrutiny. Co-ordinators working in an 'exemplary' role in the classrooms of colleagues also face judgement in terms of their skills and effectiveness. Not only must the co-ordinator be seen to be successful in terms of the sorts of expertise outlined above, but she must also be able to exhibit those interpersonal skills which enable advice to be given and taken without loss of face on either side and create an atmosphere where such advice will be freely sought.

6.2.2.3 The responsibility of classroom teaching

The responsibility of class teaching, carried by the great majority of mathematics postholders in addition to their subject responsibility, can be a conflicting priority (Campbell, 1985). It is a responsibility felt to carry increasing demands since the introduction of the National Curriculum in 1989 (Pollard et al., 1994). Increasing class sizes experienced by many primary teachers in the past few years have created additional difficulties, not the least of these being organisational ones.

Not only is a class responsibility seen to be an onerous and time-consuming one, but limited experience of teaching across the whole age-range in a school might be seen to affect the co-ordinators confidence in her role as 'teacher educationalist' and the confidence of her colleagues in advice and expertise proffered. Stow's (1988) analysis of questionnaire data from co-ordinators indicated a strong tendency for the co-ordinator to have class responsibility for the oldest age group in the school. The main implication from this finding, Stow felt, was that the co-ordinator might have only limited experience and knowledge of the full age-range.

6.2.2.4 Matching resources to needs

A job-specification which outlines responsibilities without providing the resources to meet those responsibilities will be a source of strain to a postholder. Lack of non-contact time in which to work alongside other colleagues and gain some oversight of their practice makes monitoring and evaluation an untenable expectation. The co-ordinators in Osborn and Black's category of 'critical friend' were, of necessity, using non-contact time - an indication of support and the prioritising of their role by their headteachers. In those schools where co-ordinators had moved on from being resource gatekeepers, the two key factors of non-contact time and leadership support were felt by Osborn and Black to have been instrumental in this movement (Osborn & Black, 1994, p. 29). Harwood (1992), reporting on the Support for Innovation Project (1989) in a secondary school context, concluded that it was crucial that the requisite support should be provided by senior management, and that support should include a clear definition of role.

Campbell (1985) noted that lack of time was a major factor influencing the ease with which a co-ordinator's role could be exercised. Nias, Southworth & Yeomans (1989), although reporting at a time of industrial action by teachers which severely curtailed such activities as staff meetings, noted co-ordinators functioning in each of Campbell's classifications of time - 'non-contact', 'group', 'snatched' and 'personal' (Campbell, 1985, pp. 160/2) - working alongside other teachers in the classroom, organising and leading working groups, using spare moments in the day to catch other teachers informally, and devoting their own time to carrying out their role (Nias et al., 1989, p. 120).

6.3 Co-ordinating mathematics at Greenside School - the practice

This section is supported by data from Interviews: 9, 10, 15, 19, 20, 21, 22; fieldnotes; vignette of Ruth (MC, KI). The holder of the co-ordinator's post, Ruth, was closely involved with the research from its beginning in June 1993 when the school was selected, until her departure on maternity leave in October 1994. She was replaced as maths co-ordinator by Nell, new to the school and taking a Reception class. Although Nell was co-operative at all times, she was new to the school and the timing of the changeover meant that I was not able to establish as close a relationship with her over the next few months as I had with Ruth. The major part, therefore, of Section 6.3 relates to the part played by Ruth as the maths co-ordinator at Greenside.

6.3.1 Ruth

Ruth, the mathematics co-ordinator in post at the beginning of the research, was a long-established member of staff at Greenside School. In September 1993 she was in her tenth year of teaching at the school, and her eighth as mathematics co-ordinator. She had taught a wide range of age-groups in both Infant and Junior departments, but since 1990 had been running the Nursery which was set up at that time. Ruth's qualifications in mathematics included two 'A' levels and mathematics as a main subject in her BEd course. She had pursued additional professional development linked to her role in the Nursery by undertaking an early years course and held the position of early years co-ordinator in the school management team (as described in Chapter 5).

Ruth (MC, KI) shared the Headteacher's anxiety about the mathematics practice at Greenside, feeling that this was not coherent throughout the school in terms of the use made of commercial mathematics materials and approaches to mathematics teaching. Staff had requested help with the implementation of Ma1 and for this reason 'practical/investigational mathematics' had been given priority on the School Development Plan (SDP) for 1993/94 (See Chapter 4). Further discussions about the priorities established on the SDP had led to the realisation (expressed at the initial visit of the researcher to the school) that a new 'progression' for mathematics which included the process skills of Ma1 together with the other content areas was needed; it would not be possible or desirable to attempt a 'progression' solely for Ma1.

6.3.2 Expectations

Expectations of the role of mathematics co-ordinator at Greenside were high. Ruth's job specification included both the more routine aspects of the role (resource gatekeeper) and those aspects requiring action as a 'teacher educationalist'. This latter part of the role included major inputs into mathematics curriculum development and whole-school planning and the provision of subject expertise in a consultative relationship with other teachers. Monitoring of other teachers' planning was not expected nor was provision made for this, but some oversight of mathematics throughout the school was part of the specification.

> *The Head is the only one at the moment with that overview of what people are putting into their planning. We haven't as co-ordinators got to that stage yet, looking at people's planning. I think that was one of the views that it should come, our roles should develop to be a ... because it's very hard to have an overview when you don't know what people are doing.* (Ruth, MC, KI, Int. 15, January '94)

Ruth seemed to have created an atmosphere around mathematics which enabled other teachers to come to her for advice. There were several instances of this over the two years of the research. For example, one of the newly qualified teachers in September 1993 (Tania, WG2) had felt able to talk to her about help that she would need in the future, and Valerie in March 1994 requested help following a move from a Year 2 to a Year 4 class (Fieldnotes 25, March '94). The existence of a culture in the school which encouraged teachers to admit to difficulties and seek support has been documented in Chapter 5. Ruth's own gentle manner and self-deprecating attitude may well have helped other teachers to air insecurities openly. It also, however, reflected a lack of confidence in her own abilities in the co-ordinator's role.

6.3.3 Tensions within the role

During the course of the research, Ruth herself identified several of the tensions outlined above (Section 6.2.2), relating to the translation of expectations into effective ways of working.

6.3.3.1 Subject knowledge and the teacher as 'educationalist'

Ruth felt reasonably assured in her subject knowledge of the content areas of mathematics. In her role as 'teacher educationalist' she conducted Infant/Junior meetings on the maths progression with confidence:

> The Infant group has a cohesive feel about it although there was more disagreement this time over items in the progression and where they should be placed. Ruth is much more confident in this group [than in whole-staff meetings] and held out strongly against changes being made to what she regarded as good practice. (Fieldnotes 20, Infant mathematics meeting, February '94)

She could also provide the necessary subject knowledge to explain particularly the higher levels of Attainment Targets 2 to 5.

> Teachers appeared to feel free to express ignorance about certain terms in the National Curriculum and to request help with these[...] Between them, Ruth and Meg were able to answer these difficulties pretty well [...] There is clearly quite a bit of uncertainty when reaching Level 5 [...] and quite a few teachers commented that a lot of this mathematics had been very much at secondary level in the past (Fieldnotes 29, Junior mathematics meeting, March '94).

Her expertise in drawing up the progression curriculum document (see Chapter 4) in consultation with other staff was clearly valued, and seen as a useful activity.

> Liz concluded the meeting by expressing her appreciation of Ruth's work, and how useful it would be to all of them, and this was reinforced by all the staff present. She said how useful it had been to talk through the progression all together, *"actually talking about it makes all the difference"*. (Fieldnotes 29, Junior mathematics meeting, March '94).

The freedom with which teachers felt able to express their ignorance openly was an example of the secure atmosphere which had been created at Greenside (See Chapter 5) and was clearly a tribute to Ruth's sensitivity. She showed the extent of her interpersonal skills when discussing how she had varied her approach and intervention from class to class during the visits to classrooms she was able to make in September/October, 1994 (Int. 22, October '94).

Ruth's confidence did not, however, extend to the area of 'Using and Applying Mathematics' She was unsure, not only of her own understanding of what the attainment target entailed, but also of her ability to clarify the attainment target for other teachers.

> *... and 'I'm not sure that I understand it [Ma1] ... completely, so that doesn't help, my own sort of lack of understanding about what they really mean, what they're aiming at, because I mean the statements are ambiguous, broad, sort of -*

I'd love to talk to whoever wrote them and say 'what did you mean?'. Cos the one example, you look at the one example, you think, 'Oh fine I can do that', but that's not covering it. (Ruth, MC, KI, Int. 9, January '94)

Although she sympathised with the aims of the target (describing the non-statutory guidance as the best bit of the maths document) she had not been able to translate these into plans for supporting other teachers.

No, I just think everybody, we'd started putting more and more on the planning, ATs and things, and I think people realised they couldn't put down, or they didn't know how to put down AT1, the same when it came up in science. I think that's why it was asked for, but obviously anything we've done so far hasn't clarified it, and I'm not sure that my progression yet does either, because it's so hard to put down. It's easy to do a progression in Number or Shape, but not Using and Applying. (Ruth, MC, KI, Int. 9, January '94)

Ruth also revealed lack of confidence about the suggestion of holding a maths meeting with parents, trying to explain what they did in school, saying *"to be honest I felt daunted by the idea. [...] I don't feel confident enough to do that, I would ask the advisory teacher"* (Int. 22, October '94).

In reflective mood during the third interview with Ruth the day before she went on maternity leave (Int. 22, October '94), she was able to articulate how this constraint of her own lack of understanding of Ma1 had affected her ability to help other teachers. She had allowed herself to be distracted by the onerous work load of writing the two curriculum documents (the progression and the topic framework) from really addressing the issue of how to approach Ma1. (The word 'bits' in the following quotation refers to objectives identified in the SDP 1994/95.)

Yes, we've sort of worked through the other bits, and keep skirting round that bit, but that's the bit that's left now, actually sorting out ... a) some investigations that we have to do and b) how we really start to do AT1, so it's still ongoing. (Ruth, Int. 22, October '94)

6.3.3.2 The responsibility of classroom teaching

The class responsibility of the Nursery was very important to Ruth, and created conflicts about priorities in school time. Much of her work on the maths progression was done at home ('personal time', Campbell, 1985, pp. 160/2). The Autumn term in a Nursery (when, in 1993, the pressure to write the progression in consultation with other teachers was greatest) brings with it the difficult task of settling in new children, many of whom are unused to leaving parents and participating in a wider social arena.

In contrast to the co-ordinators in Stow's research, Ruth's most recent concentration of teaching experience was with the youngest children in the school rather than the oldest, although her experience in previous years had spanned a wide age-range. Working daily with a pre-National Curriculum age-range made it additionally difficult for her to keep up to date with curriculum requirements, the full range of which she was not herself practising in the classroom.

6.3.3.3 Matching resources to needs

As revealed in the quotation from Ruth above regretting her lack of an overview of mathematics in the school (Section 6.3.2), Ruth felt the tension between the expectations of an 'overseeing' role and the lack of facilities or non-contact time to carry this out. This is not to say that some support was not provided in terms of release from the classroom, but as the Nursery teacher, working to a different timetable to the rest of the school, she felt she was not able to keep up to date with mathematical developments throughout the school.

> *And I just haven't had the time, my timetable doesn't work that I can get into classrooms and help.* (Ruth, MC, KI, Int. 9, January '94)

> *I find doing maths throughout the whole school a horrendous task, actually.* (Ruth, MC, KI, Int. 9, January '94)

During her last half-term before maternity leave in October 1994, the intention to give Ruth time to consult in other teachers' classrooms was frustrated by teacher absences and Ruth's need to act as a cover teacher, often at very short notice. The small number of occasions on which she did manage to maintain her timetable of classroom visits resulted in developments in her own practice and in encouraging signs of an active interest in changing practice from some colleagues.

> She realised that her time out of the Nursery and in classes before she went on leave had given her time for reflection, and she felt that her own ideas about how to incorporate Ma1 had developed. She had either worked on teachers' suggested activities and tried to open these out, and show teachers how she was doing this, or she had taken in an investigative type of activity herself, or she had worked with one of the activities suggested by the adviser. I asked whether she would have felt confident about doing these sorts of activities before the whole-school focus on Ma1 began, and she said that she realised that her own confidence had grown .... (Vignette of Ruth, MC, KI, March '95)

Secretarial assistance was made available to co-ordinators for the typing up of, for example, curriculum documents, but Ruth admitted that she was hardly ever able to take

advantage of this because she was always doing things at the last minute (Fieldnotes 7, October '93).

6.3.4 Support structures for the co-ordinator

6.3.4.1 Support from the Headteacher

The Headteacher had, through the management structure established at Greenside, delegated subject responsibilities to individual members of staff through working groups (with the departmental group on occasions acting as an intermediary). As in all complex institutions, decisions sometimes needed to be made quickly and could only be made by the Headteacher. Direct access to the Headteacher by all members of staff appeared to be an accepted part of the way the school worked. As a mathematics co-ordinator herself earlier in her career, the Headteacher made no secret of her support for the mathematics development and I noted this support on several occasions. It was exemplified in the provision by the Headteacher of non-contact time for Ruth to consult with the maths adviser from the LEA, and by the immediate arrangement of supply cover for Inset activities when requested in February 1994.

> The proposed visits from the adviser in the summer term have already been cleared by the head. The adviser's time is still free to schools, but cover for class teachers to observe will need to be paid for by the school. (Fieldnotes 18, January '94)

Resources were quickly ordered once they had been suggested and approved.

6.3.4.2 The mathematics working group 1993/94

The development and use of working groups for different areas of development at Greenside School have been discussed in Chapter 5. The group set up to facilitate the development of 'practical/investigational mathematics' itemised on the School Development Plan for 1993/94 consisted of only two teachers, Meg and Ruth.

Meg was the only other teacher at Greenside at that time (apart from Ruth) to possess qualifications in mathematics at 'A' level. She had initially trained as a barrister before changing direction and turning to teacher training and primary teaching. She was in only her second year of teaching in September 1993, but an indication of the regard in which she was held by the Headteacher was that she had been assigned to a Year 6 class containing several children with recognised behavioural and learning difficulties.

> *... it's acknowledged that the behaviour is the hardest, but also they've got a huge spread. I've got a third of the class who are "below average ability"*

which is quite hard, and then I've got one boy at the other end who's very bright, so the spread is huge. (Meg, WG1/2, Int. 10, January '94)

Meg confessed to not being happy with her teaching of mathematics to this class, relating this to the difficulties she had found in the class.

... what I find difficult this year is the basics just are not there, and so that seems, that really has altered the way I'm teaching maths this year, from what I would like. I'd like to do a lot more investigative work, but I'm finding I'm just having to do so much basic number work 'cos it just seems to me that you're just so restricted if you haven't got your basic concepts, you really can't do much more... . (Meg, WG1/2, Int. 10, January '94)

Meg had not yet reconciled her beliefs about how she should be teaching mathematics with her experience of what she felt to be feasible in her own classroom.

She supported the use of working groups in the school - "I *think working groups work well but as long as there aren't too many people, I think it's good to get sort of two or three of you, heads together, and get down to it*" (Meg, WG1/2, Int. 10, January '94) - and appeared to enjoy working with Ruth. However, she and Ruth shared the opinion that, because they were the only two teachers in the school with overt expertise (ie qualifications), assumptions had been made about their involvement.

No, I think it's "Oh, that's Ruth and that's Meg". I think people have just assumed a level of expertise in Ruth and me and then think "Oh well that's their job." (Meg, WG1/2, Int. 10, January '94)

No, I mean last year it was just Meg and I doing it on our own. That seems to be the way with the maths ... (Ruth, MC, KI, Int. 9, January '94)

Ruth felt that the reason for this delegation of responsibility was lack of confidence in mathematics. In this same interview, Ruth referred back to an Inset session she had conducted with the maths adviser eight years previously when some teachers had been reduced to tears by feelings of inadequacy engendered by an investigational activity. *"I know maths is not people's strong point, a lot of people, I know, haven't got the confidence"* (Ruth, Int. 9, January '94). Even while accepting this lack of confidence, she also associated the delegation of responsibility with a lack of interest on the part of other members of staff: *"nobody's volunteered, and nobody's shown any sort of interest in ... so other than Meg helping me, I'm doing it on my own."* (Ruth, MC, KI, Int. 9, January '94).

These two teachers worked together on the objectives established for 'practical/investigational mathematics' in the SDP; however the emphasis appears to have been on organising and selecting new mathematics resources and making arrangements for the first adviser's visit in June 1993. From documents available, they do not appear to have discussed together how the progression (mathematics curriculum document) could incorporate Ma1, or what the needs of teachers might be in implementing the area.

The initial interviews with Meg and Ruth took place after the January 1994 SDP meeting (Fieldnotes 14, January '94) at which the decision was made to continue with Ma1 as a focus for development, but to change the title to 'Using and Applying Mathematics'. Both teachers were initially somewhat taken aback and disappointed at the expressions of lack of progress voiced at this meeting but reflection led to rather different responses. Ruth felt that the work they had done during the year - building up a file of investigative activities, re-organising resources, organising a visit from the adviser - had achieved little. *"I felt, what had we done in the year? And Meg and I thought we'd worked hard getting some of it off the ground, and obviously it wasn't enough, so ... so I was disheartened, but you go on."* (Ruth, MC, KI, Int. 9, January '94) She searched for reasons for this, mentioning lack of time to maintain the regular meetings she wanted and lack of opportunities to get into classrooms to help other teachers. Meg felt that other teachers were not taking sufficient responsibility.

> *... the folder is there full of ideas and investigations, but nobody has gone to look at it .... [...] I just feel at some stage that there's a limit to the amount of spoon feeding ..."* (Meg, WG1/2, Int. 10, January '94)

No doubt these differing reactions reflected to some extent differences in personality and personal confidence, but also the ultimate responsibility of co-ordinating mathematics in the school, which belonged to Ruth.

6.3.4.3 The mathematics working group 1994/95

The changeover in working groups to meet the requirements of the SDP for 1994/95 took place in April 1994. Two maths working groups were now required - for 'Using and Applying Mathematics' and for Data Handling. An additional two teachers (Tania and Carol) were recruited to join Meg and Ruth on the former group by the persistence of the headteacher in calling for volunteers (teachers were less forthcoming for this group than for others (Fieldnotes 14)). Carol held a part-time job-share post and Tania had joined the group because she thought it might help her own feelings of insecurity about maths and neither were able to provide strong support. The first meeting of this group (Fieldnotes 35, June '94) revealed a general lack of ideas for tackling the aim of

encouraging good practice in the implementation of Ma1, other than through Inset by the adviser. Staff illness and school pressures during the end of the summer term 1994 led to some maths meetings being cancelled.

With the imminent departure of both Meg and Ruth on maternity leave, the 'Using and Applying' group was joined by two new teachers (Nell, who was to take over the maths co-ordination, and Olivia), both of whom had studied mathematics as a main subject in teaching training. At the first meeting of this newly constituted group there appeared to be several different agendas operating, with Ruth steering the meeting firmly in the direction of resources, and Olivia trying to establish some definition of the problem identified by teachers with Ma1. There was an uneasy atmosphere.

> Tensions were evident between Ruth and Carol and between the two new members of staff, Nell and Olivia. Meg's comments about 'already doing AT1' , and Ruth's insistence on focusing on resources indicated a settling back into entrenched positions, I felt. I also felt that Olivia's participation had indicated that she thought that the issues of Ma1 were not really being addressed. (Fieldnotes 42, September '94)

When reporting back on this meeting to a full staff meeting, Meg described its purpose as having been to 'assess resources' (Fieldnotes 43, September '94).

It appeared that the new input from Olivia and Nell came at the wrong time for Ruth and she was not really able to benefit from the support of these two new teachers with strengths in mathematics - there was little time available before she left and she was anxious to leave the responsibilities of Ma1 behind. She was well aware of their strengths - *" ... I think they've both got good ideas, a bit more up to date than I've got at the moment"* (Ruth, MC, KI, Int. 22, October '94) - and felt she could learn from them, but time was too restricted for this to happen.

6.3.4.4 Support from the mathematics adviser

Having held the post of mathematics co-ordinator for some years, Ruth knew her LEA mathematics adviser (Eva Farley) well and had built up a good relationship with her, feeling able to reveal her anxieties and ask her for advice and help.

> *I chatted to her about what I'd been doing, and I said I really needed her to come and look at what I'd done so far. [...] She's a very good advisory teacher, she really does get things going when she comes in.* (Ruth, MC, KI, Int. 15, January '94)

Positive reinforcement of Ruth's work by the adviser was clearly important to her, supporting, as it did, some professional decisions she had made about the progression (eg. to keep to a levelled rather than a year group format).

The adviser was viewed in a very positive light by all the teachers who discussed her Inset sessions: one teacher described her visits as *"completely inspirational"*, another that she seemed to have ideas *"dripping out of her, almost"*; she was clearly seen as an important resource by the school.

Her approach at the whole-staff Inset meeting following her series of visits in June 1994 made it clear that she was aware of the wide range of views about mathematics and Ma1 in particular held by teachers in the school and could see the complexity of the task that faced Ruth in the development of 'Using and Applying Mathematics'. She did not attempt to 'sort out' what were clearly contentious issues at a relatively short meeting, preferring instead to leave questions unanswered, to be reflected on further (Notes on Inset Meeting, June '94).

Perhaps as a result of their good relationship, enabling Ruth to admit to difficulties, discussions between Ruth and the adviser produced a course of action (to include specified activities incorporating Ma1 in the school planning documents) which, as will be seen in Chapter 8, was to prove fruitful in terms of encouraging teachers to engage with the process of change.

The adviser thus played a role supportive to the co-ordinator at both professional and personal levels and this role was in turn supported by the Headteacher in terms of the necessary provision being made.

6.3.4.5 Support and constraint from the School Development Plan

It may seem something of a paradox that the SDP could be both a support and a constraint to the mathematics co-ordinator, but analysis of the working group meetings and subsequent feedback to staff meetings indicated that this was indeed the case.

The objectives for the development in 'practical/investigational mathematics' were defined early in 1993, to be worked on from April of that year (See Chapter 4). Three of these could and did result in a focus on resources: to evaluate and bring to the attention of staff existing investigational/practical ideas; to review any new resources available with a view to extending existing school resources (particularly for AT1); to collate a school bank of ideas. The fourth, to review the progression of skills used for

investigation/practical work through the school (later extended to become a progression of skills for the whole of mathematics) was seen as a curriculum development exercise, but strategies for engaging staff in the development of Mal were not specified, staff development requirements being described in terms of encouraging staff to use existing resources and to share ideas, to attend twilight sessions (unspecified, but later undertaken by the adviser) and to receive in-class support from the LEA adviser.

Having these objectives and strategies defined in this way seemed to act both as a support for the co-ordinator and as a constraint on the development of other strategies during the year. It was clearly the co-ordinator's responsibility to work towards the fulfilling of these objectives and Ruth pursued this task conscientiously. She referred to them frequently and seemed supported by their existence. However, once down 'in black and white' it seemed that it was difficult for other strategies to be considered.

Because of unavoidable difficulties at the end of the Christmas term 1993, it was not possible to evaluate the success criteria of the work so far undertaken on 'practical/investigational mathematics' before the Inset day to decide on priorities for the next year's plan. The meeting at which some evaluation did take place did not seem to be a forum for further discussion (Fieldnotes 15, January '94) and was more of a 'reporting back' exercise. The Headteacher, when discussion of the following year's SDP was started, appeared anxious to work on the objectives for 'Using and Applying Mathematics'.

The issue of on-going evaluation will be addressed further in Chapter 9. In the absence of structured opportunities for this to take place it appeared that the co-ordinator found it difficult to consider amending or restating what was needed in terms of staff development - the SDP was, in effect, acting as a constraint upon her action.

6.3.5 Nell

Nell's responsibility, when she took over the role of maths co-ordinator in October 1994, was to complete those parts of the SDP which had not yet been addressed. Although quiet and unassuming in manner, she did not share Ruth's lack of confidence in approaching Mal and the first meeting of the working group that she led in January 1995 indicated that she was prepared to lead from the front with her own experiences. This working group also had tensions within it. Although some initial unease between Nell (MC, WG2) and Olivia (WG2) seemed to have evaporated, disagreement emerged

between Olivia and Carol (WG2), in terms of the need to get specific responses from staff in order to evaluate progress, which were not resolved (Fieldnotes 54, January '95).

Nell (MC, WG2) conducted further meetings with both Infant and Junior departments on investigations to be included in the topic planning document, meetings in which she drew on her experience and knowledge to make her views plain. Structures for working, and support in carrying out the work, seemed to remain the same for the mathematics co-ordinator, the main differences between Nell's situation and Ruth's possibly being the positive support of Olivia (WG2) whose views about mathematics and the incorporation of Ma1 as central to mathematics teaching appeared to match her own (Nell, MC, Int. 21, October '94), and the need for Nell to establish a good working relationship with the mathematics adviser.

The meeting to compare approaches by different classes and teachers to similar investigational activities, the levelling meeting (Fieldnotes 58, March '95), provided a forum for a discussion of the assessment of Ma1. At this meeting there was a sense of struggle - of teachers trying to look more deeply at issues that had previously not been addressed; the forum of this meeting and a similar one in the Junior department (not observed) was commented on by most teachers in the final interviews (see Chapter 8) as having been beneficial.

6.4 Conclusion

Ruth's experiences as mathematics co-ordinator at Greenside School have been considered in the light of potential expectations and tensions inherent in the role as suggested in the literature.

Expectations were high and had become higher with the placing of the development of 'practical/investigational mathematics' on the School Development Plan (SDP). In terms of Osborn & Black (1994)'s four levels of increasing demand in the co-ordinating role, Ruth was expected to be resource gatekeeper, planning and resource facilitator and subject consultant. Her role as a planning facilitator had been increasingly demanding over the two years in which she was carrying out the requirements of the SDP involving not only a complete new mathematics progression for both key stages 1 and 2, but also the re-working of this into a format to fit the topic framework for planning. The established way of working in the school, using a collaborative development model in which the co-ordinator solicits involvement from staff at regular intervals and feeds back to them the draft documents in varying stages of completion, made additional

demands on her as subject consultant. Efforts were made by the school to provide the resources implied in these expectations; where provision was not made, as in the case of making planning documents available to the postholder, expectations of monitoring were not regarded as part of the role.

Ruth felt that resources did not meet needs in that part of her role requiring an oversight of mathematics in the school. In order to meet this requirement she felt that she should be acting as a 'critical friend' - working alongside other teachers in the classroom (Osborn & Black, 1994, p. 5). There were very few occasions on which she was able to do this, and never on a regular basis. When Ruth was able to undertake this role, it seemed to have helped her as much as other teachers in clarifying some of the issues related to Ma1 and appropriate ways of working.

The Headteacher at Greenside School was not satisfied, either, with this mismatch between expectation and resource, the role of co-ordinators also having been identified by the OFSTED inspection as one of the key issues for the school to address. The role of the co-ordinator was given a high priority on the SDP for 1995/96 and a working party set up to address, amongst other things, the formulation and evaluation of *"an effective method of monitoring and evaluating a curricular area"* (Summary Action Plan for working group, SDP 1995/96). By the end of the school year in 1995, the mathematics co-ordinator (Nell) had been selected as the pilot postholder to be given non-contact time the following year to engage with this task - another indication of the desire of the Headteacher to keep up the momentum of the mathematics development.

Ruth was honest enough to admit that resources did not meet needs in terms of her understanding of Ma1. Her support structures, colleagues, working group, adviser, had not been sufficient to clarify for her the meanings behind the attainment target, and she had thus *"skirted round"* the issue with other teachers, preferring instead to focus on the safer areas of content attainment targets and resources. However the nature of the statements of objectives in the 1993/94 SDP allowed this focus and, as has been discussed in Section 6.3.4.5, became something of a constraint. The opportunity for the teachers at Greenside to participate in an open discussion which addressed their difficulties with Ma1 in some depth was not provided during the maths development - an opportunity valued by teachers in O'Connor's small-scale study where one individual described feeling *"cleansed"* by it (O'Connor, 1994, p. 17).

The translation of objectives into appropriate action is considered by Howard and West (1991) in their checklist of issues for co-ordinators. They include as necessary

components of the role of co-ordinators, the planning and working out of how objectives are to be achieved; the evaluation of the progress and effectiveness of the activities they have organised and the setting of new objectives in the light of past achievements (Howard & West, 1991). The problems experienced at Greenside School in maintaining an evaluation framework will be returned to in Chapter 9.

Ruth's excellent working relationship with the mathematics adviser resulted in a strategy beneficial to the development of Ma1 in the school. However, it is quite possible that the expectations of Ruth in the year 1993/94 in terms of the preparation of curriculum documents were so great that not enough time was left for personal reflection about 'Using and Applying Mathematics'. She was already using 'personal time' to complete these documents.

Campbell (1985) described the difficulties encountered by teachers in giving accounts of the curriculum to professional peers in the context of History. "Perhaps the most difficult area was a directly practical one: the need to specify, organise and explain the major conceptual and skill structures of a subject." (Campbell, 1985, p. 80).

The following quotation encapsulated Ruth's difficulties:

> It is not being suggested for a moment that postholders were required, or should have been required, to undertake a substantial formal 'course' in educational theory before engaging in school-based curriculum development, but once they had engaged in it, they were confronted with the need to adopt ideas and forms of discourse with which, initially at any rate, they were unfamiliar and insecure. Such insecurity was only intensified if familiarity had to be acquired in haste and alongside more routine but exacting demands of everyday teaching. (Campbell, 1985, p. 80)

Ruth's absence on maternity leave meant that she did not see some of the positive results of her efforts to lead the development of Ma1 in the school, and she felt that, to some extent, she had failed (Vignette of Ruth, MC, KI, March '95). Indications of positive responses, developing over time, were revealed in the final interviews, and are discussed in Chapter 8.

The demands and difficulties of the role of Ruth, the mathematics co-ordinator at Greenside School have been discussed in this chapter in the light of relevant literature. A co-ordinator does not choose the group of teachers with whom she works; she works with teachers in her school. It is these individual teachers that form the subject of the next chapter.

Chapter 7. The heart of the matter - the individual teacher

> Educational change depends on what teachers do and think - it's as simple and as complex as that. (Fullan , 1991, p. 117)

7.1 Introduction

In Chapter 6, the role of the mathematics co-ordinator was discussed in terms of the expectations and constraints on the teacher filling the role. Among the factors not discussed specific to the co-ordinator's role (but implicit in that part of the role described as the teacher as 'educationist') was the disparate nature of the group of teachers with which a co-ordinator might find herself working. There might be, for example, teachers who were far more experienced than the co-ordinator in organising and conducting Inset sessions and leading group activities, as well as those who had never taken a leadership role. There might be teachers who responded particularly well to the type of interpersonal skills natural to the postholder whereas others found them difficult to relate to. There might even be teachers whose subject knowledge of mathematics was as good, if not better than the co-ordinator's, as well as those with very limited subject knowledge.

What is certain is that there will be, in any school, teachers at differing ages and stages of career, holding a variety of beliefs about ways of working within the school context and culture and with varied personal circumstances. Fullan and Hargreaves' insistence on a consideration of the 'total teacher and the total school' (Fullan & Hargreaves, 1992a, p. 5) is a recognition of these and other disparities which exist in any group of teachers and of the effect that individual characteristics can have on the implementation of change. In this chapter another layer is peeled back and the heart is revealed - the individual teacher, a person with a purpose, working with children in the classroom.

The individual teacher is the focus of this chapter and the one that follows. A selection of the literature relating to beliefs about mathematics and its teaching, and to more personal factors of age, experience and stage of career provide a context for discussing the teachers at Greenside School as they appeared at the beginning of the research. The following chapter (Chapter 8) moves on in time from the initial interviews and considers the changes that took place during the two years of the mathematics development.

7.2 The teacher's purpose

Teachers all possess a set of beliefs about what and how they should be teaching. They value certain ways of working with children and gain satisfaction from putting their aims into practice. Teachers connect their major rewards with classroom events and these 'psychic rewards' of teaching (Lortie, 1975, p. 101) compensate, in many teachers' minds, for the hard work and stressful nature of the job. In terms of the teaching of mathematics, the teacher's purpose includes her beliefs about mathematics and how it should be taught to the children for whom she is responsible. The teacher's own knowledge and understanding of mathematics will contribute to the formulation of these beliefs but is distinct from them, as discussed below (7.2.1.1). Experiences which affect the way in which a teacher's knowledge and understanding of mathematics is built up are discussed in section 7.3, The teacher as a person.

7.2.1 Beliefs about mathematics and its teaching - the literature

There has been increasing recognition in recent years of the importance of a study of teachers' beliefs as part of understanding the processes of teaching and learning mathematics in the classroom. However the focus of these studies has varied: some have looked at beliefs about the nature of mathematics, relating these to models of teaching; some have looked at beliefs about the teaching of mathematics, relating these to practice and others have looked at the relationship between beliefs about the nature of mathematics and classroom practice. The possibility of changing teachers' beliefs as part of a process of changing practice has also been the subject of research.

7.2.1.1 The nature of beliefs

In Fullan and Hargreaves' four part model described earlier (Fullan & Hargreaves, 1992a) the teachers' purpose relates to the beliefs and values held by teachers. The knowledge that teachers have acquired and that they bring with them to their teaching will have played a part in the formulation of their beliefs, but should be distinguished from them in several ways. Thompson (1992) described several distinctions between belief and knowledge, drawing on the work of Abelson (1979). Firstly, beliefs can be held with varying degrees of conviction.

> The believer can be passionately committed to a point of view, or at the other extreme could regard a state of affairs as more probable than not [...] This dimension of variation is absent from knowledge systems. (Abelson, 1979, p.360)

Secondly, beliefs are not consensual. Disputability is associated with beliefs; truth or certainty is associated with knowledge, although this can change, or be adapted. What may at one time have been considered knowledge may, at a later time, become a belief. Knowledge must meet certain criteria about how it is to be evaluated and its validity established. Beliefs may be held for a variety of reasons, and there may be no agreement about how they are to be evaluated. Thompson (1992) suggested conceiving of belief systems - how individuals' beliefs are organised - in much the same way as cognitive structures, describing belief systems as "dynamic in nature, undergoing change and reconstruction as individuals evaluate their beliefs against their experience" (p. 130).

Beliefs are not all held with the same degree of certainty; Green (1971) described central and peripheral beliefs, the central ones being those most strongly held. The holding of certain beliefs may imply the holding of others, and Green identified primary and derivative beliefs, stressing that a belief is never held in total independence of all other beliefs. Green's third dimension related to the clustering of beliefs, which prevented cross-fertilisation among clusters or confrontations between them, thus making it possible to hold conflicting sets of beliefs.

7.2.1.2 Beliefs about mathematics

Work on teacher beliefs has in many cases taken as a model Perry's (1970) hierarchical classification of how people make meaning from their experiences. Relating this system to beliefs about mathematics, Larry Copes (1979) reduced Perry's levels from nine positions to four and described these as absolutism (referred to by others as dualism, see Oprea and Stonewater, 1987), multiplism, relativism and dynamism. Absolutist beliefs regard every question as having an answer, there is a solution to every problem, and it is the role of authority to know and deliver those answers. In the multiplistic view, everyone has the right to their own axiom system and all are equally good. Relativists consider that not all opinions are equally good and there are standards such as validity (which will depend on context), internal consistency and consistency with observed data which must be observed. Those espousing dynamism are aware that knowledge is not something 'out there' to be absorbed, exposed to, acquired. A person's knowledge is something that he or she must build alone. In a qualitative study undertaken with a small sample of preservice teachers, Owens (1987) used Kelly's (1955) Personal Construct Theory and Perry's developmental scheme (positing four major stages of dualism, multiplism, relativism and commitment). The results of this study highlighted "the broad differences in perceptions of teaching and of mathematics

that can exist between two ostensibly similar participants in a teacher education program" (Owens, 1987, p. 169).

McLeod (1987) expressed unease about the application of Perry's levels to mathematics education feeling that this approach did not take into consideration the subjects' specific knowledge of mathematics or their level of general ability and the ways in which these kinds of knowledge might influence their performance on measures designed to classify people into categories of dualism, multiplicity and relativism.

Lerman (1983) considered a simpler model consisting of two positions - the absolutist and the fallibilist approaches. The belief in mathematics as a body of knowledge implies that "one must learn methods first and understand uses, applications or relevance afterwards" (p.62). Mathematics through problem solving, the fallibilist or quasi-empirical approach, sees the basic method of mathematics as searching out the answers to problems, with uncertainty being accepted as inherent. However there are dangers in regarding teachers as belonging to one or other of these two extremes. Particular views may not be held exclusively. Brissenden (1980) emphasised this point, having noted two positions similar to those described by Lerman.

> It would be a mistake to portray mathematics teachers as belonging to two opposing camps; they are far too varied a group for such simplifying treatment. It might be better to think of the two outlooks just described [mathematics as a body of knowledge, mathematics as a way of knowing] as forming a kind of dialectical tension within ourselves. (p. 72)

Oprea and Stonewater (1987) conducted a case study with 13 mathematics teachers in an attempt initially to measure their cognitive development and their beliefs about mathematics. They found inconsistencies between their data, and the way they expected the constructs to be related. They hypothesised that "Perry levels might be different with regard to how teachers think about *teaching* mathematics and how they think about the *content* of mathematics." (p.160) They suggested that the Perry assessment instrument needed to be revised to separate out the "potentially confounding mix of pedagogy and content" (p. 161).

7.2.1.3 Beliefs about the nature of mathematics and beliefs about the teaching of mathematics

The importance for teaching of the conception of the nature of mathematics has been noted by Ernest (1989). He distinguished three positions: the instrumentalist view of mathematics as an accumulation of facts to be used in the pursuance of some external end; the Platonist view of mathematics as a unified and static body of knowledge and

the problem-solving view of mathematics as dynamic and continually expanding. Ernest linked these views of the nature of mathematics to teachers' mental models of teaching and learning.

Lerman (1986) produced data from a study of preservice secondary teachers to support a correspondence between the two conceptions of mathematics he identified and alternative views of teaching; however he emphasised that teachers are not necessarily conscious of the relationship between views of the nature of mathematics and the way in which mathematics is taught. Thompson (1984) found that this relationship was a complex one with many factors appearing to interact with the teachers' conceptions of mathematics and its teaching.

Richard Skemp (1978) discussed how two different conceptions of mathematical understanding, which he described as 'relational' and 'instrumental' could account for differences in teaching practices. Although this was a theoretical discussion, there are close similarities with the bi-positional models described above.

7.2.1.4 Beliefs about the teaching of mathematics and the practice of teaching

In addition to beliefs about the nature of mathematics affecting beliefs about teaching, the effect of teachers' beliefs about teaching mathematics have also been considered, and how these relate to classroom practice. Thompson's study (1984) found some discrepancies between professed beliefs about teaching and instructional practice, as did Brown (1985). The subject of this latter study, Fred, compromised his belief in problem-solving as an instructional goal in response to the social context in which he found himself teaching and what he perceived as the attitudes of his students towards mathematics. Student's beliefs about mathematics (Kouba and McDonald, 1987) add another dimension to the possibility of the teacher being able to carry through into practice her conceptions of how mathematics should be taught. Thompson, however, concluded

> Although the complexity of the relationship between teachers' conceptions of mathematics and mathematics teaching cautions against making conclusive statements, the findings supported the original assumption that led to this investigation. That is, teachers' beliefs, views, and preferences about mathematics and its teaching, regardless of whether they are consciously or unconsciously held, play a significant, albeit subtle, role in shaping the teachers' characteristic patterns of instructional behaviour. (Thompson, 1984, p. 124/5)

Desforges and Cockburn (1987) pointed to the complexity and sheer volume of 'information processing' (p. 121) demands made on the primary teacher in the classroom

as affecting the ability to carry through intentions into actual practice. Block & Hazelip (1995) noted problems with focusing on beliefs to the exclusion of other important factors.

> ... the literature tends to focus on teacher beliefs and belief systems about a small portion of their job; while issues of the management of student learning and classroom achievement are high on most teachers' planning list, issues of the management of learners and classroom discipline often are even higher. (p. 25)

The focus on the classroom and the wider teaching context is a welcome recognition that there is no simple linear relationship between beliefs and practice. The inconsistencies noted earlier (7.2.1.2) by Oprea and Stonewater (1987) are but one example of the complexity of the relationship between beliefs and practice. Hoyles (1992) suggested that all beliefs were 'situated' (p. 40) and that a distinction between beliefs and beliefs-in-practice was problematic.

7.2.1.5 Changing beliefs, changing practice

The structure of belief systems will necessarily affect changes to these systems. Skemp's ideas of assimilation into, or accommodation of, existing schema have been used by Lerman (1987), tracing ineffectual change to assimilation without accommodation. Ideas are fitted into existing schema; current schema are not restructured. Lerman found that teachers' responses to a new external examination requiring students to carry out investigations and course work resulted in didactical responses, rather than a change in teaching style.

Pirie (1987) engaged in a two year research project on helping teachers to change their classroom styles to incorporate a more investigative approach. While the results of this study were based on teachers' own evaluation of change experienced, it was nevertheless the case that some teachers' perceptions were that they were undertaking more investigative work, and felt more confident in this area. The factor of pupil resistance to a change of teaching style was also raised in this study, but teachers felt that with persistence, pupils resistance lessened.

Attempts to affect the practice of primary teachers have also been the subject of research. Carpenter et al (1989) documented success in changing beliefs and practice by giving teachers access to knowledge from research on children's mathematical thinking, although Clark and Peterson (1986) reported contrasting findings - that teachers did not tend to base instructional decisions on any assessment of children's knowledge. Wood, Cobb & Yackel (1991) noted changes in practice and beliefs of a primary teacher involved in a research project based on constructivist views of learning.

Civil (1993) was concerned about difficulties in the translation into the school world of changes which had become evident in the thinking of preservice elementary teachers during the course of their training.

Efforts to bring about change in the mathematics curriculum in this country to include more process-based aspects of the subject have been paralleled by a similar development in the USA - similar in the emphasis on process skills through the NCTM (National Council of Teachers of Mathematics) Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989), but contrasting in that these have been of an advisory rather than mandatory nature. Battista (1994) cited examples of teachers who possessed a view of mathematics that was "totally incongruous with that of the current reform movement" (Battista, 1994, p. 467). Ford (1994), in a study of 5th grade teachers found that these teachers believed that problem solving in mathematics was primarily an application of computational skills, and that students' beliefs were, in the most part, consistent with the teachers' beliefs. The rather judgmental tone of some of these reports - teachers did not hold the 'right' beliefs to promote the development of new ideas - included suggestions for remedying the situation by attempting to change beliefs, perhaps by confronting teachers with situations which challenged these beliefs, hoping thereby to change practice.

Hoyles (1992) argued for approaching innovation from a different perspective "not trying to change beliefs in order to have the 'right' effect but rather as a means to throw light on beliefs, beliefs-in-practice, and on the innovation itself" (Hoyles, 1992, p. 40). She stressed the usefulness of the model of 'situated' beliefs in interpreting inconsistencies in research findings on teachers' beliefs. Having conducted a comprehensive review of the literature on teachers' beliefs, Thompson (1992) concluded that the relationship between beliefs and practice was not a simple linear-causal one and requested that "further studies, particularly those having to do with effecting change, should seek to elucidate the dialectic between teachers' beliefs and practice, rather than try to determine whether and how changes in beliefs result in changes in practice" (Thompson, 1992, p. 140).

7.2.1.6 Relevance to the current research

The purpose of this review of the literature on teachers' beliefs has been to emphasise that although clearly teachers' beliefs about mathematics and its teaching impact to some extent on classroom practice, the complexity of the relationship leads to difficulty in researching the area. This is particularly true in the primary arena where most teachers have no mathematics specialism, and experiences of mathematics vary widely.

The views particularly of Thompson (1992) and Hoyles (1992) have been pointers for the focus of data collection and analysis in this study. The dangers of taking too simplistic of view of teachers' positions on any continuum of beliefs (Brissenden, 1980) and of making assumptions about any relationship between beliefs and practice that do not take sufficient account of context have been noted. The intention has not been to attempt to establish a taxonomy of the beliefs of the teachers at Greenside School about mathematics. Teachers were not asked in interviews to define their beliefs, or state their positions viz a viz different statements, but to describe some recent mathematics in their classroom and the engagement of their pupils with it. From these descriptions, the subject of the innovation (in this case 'Using and Applying Mathematics', Ma1) was drawn out or approached tangentially by the interviewer. Rather than seeking reasons for attitudes to Ma1 in belief structures, the analysis noted situations of conflict and agreement between apparent belief structures and interpretations of Ma1.

7.2.2 Beliefs about mathematics and Ma1 at Greenside school

The analysis of attitudes to Ma1 has been described in Chapter 3. Attitudes to Ma1 were coded on transcripts of the first interviews and a further analysis establishing several sub-categories was then undertaken (see Appendix 5d). These attitudes were then considered in terms of their apparent match or mismatch with more general beliefs about mathematics (when individually held), their communality within the school and their links to the three strands of Ma1 (see Appendix 7a, Table 7.1, Stranding analysis - 1). Sources of data for section 7.2.2. were the initial interviews (contextualised by early informal visits to classrooms), together with their attached interview summaries and impressions (see Appendix 6); fieldnotes and observation notes from early phases of the research were also used.

Beliefs about Ma1 as represented in the non-statutory guidance (DES/WO, 1989b) present a view of mathematics towards the quasi-empirical end of Lerman's model, mathematics as problem-solving. It is likely that teachers whose beliefs about the nature of mathematics could be placed in a similar position on this continuum would find it easier to accommodate their existing schema to incorporate the implications of Ma1. Teachers whose views of mathematics tended towards the absolutist end of the model would need radical accommodation to their schema to embrace these ideas. The next three sections draw from the analyses of beliefs and explore situations of conflict (and sometimes agreement) surrounding the implementation of Ma1 as experienced by teachers at Greenside school.

7.2.2.1 Conflicts for individuals - three short profiles

Linda's view of progress in mathematics was in a movement from the practical to the formal, even with her 5-6 year olds. By formal she meant maths in a traditionally recorded form.

> *I have a group who are very bright and really are working very formally, I've got a group who are I would say a middle group who are doing a lot of practical and a lot of formal work and a group who really are still counting, learning very basic skills.* (Linda, Int. 2, November 1993)

She emphasised children being able to 'do', rather than to 'understand', indicating that she might take an instrumental rather than a relational view of understanding. On the other hand, she felt that practical activities could be a vehicle for 'Using and Applying Mathematics', and talked about doing it in PE and when children were lining up, or during register time. Other situations she suggested were when children were working things out for themselves, or using their hands. It would therefore have been difficult for her to envisage progression in Ma1 along a similar route to that which she encouraged for her number work in particular.

Olwen described locating Ma1 in activities which children did not see as mathematics, and gave cross-curricular examples of problem-solving to illustrate this. She enjoyed, and could concentrate on because of her position as a job-share, teaching the 'formal' as opposed to the 'practical', equating the formal with number work. She felt that the emphasis on content in the National Curriculum prevented work on Ma1, and that it was also less suitable for younger children, and the less able. Olwen's classroom situation may have enabled her to focus on what she believed to be important in maths, but this separation of the mathematics between two people might well have inhibited the development of teacher and pupil behaviours indicated by this attainment target.

> *Well I quite like the formal side, that's why we arranged it the way we did, [...] and she* [jobshare] *likes a lot of movement around the room and so on and I like a little bit of glue on their trousers! So whereas she would have them all around the playground and up and down the corridors, I tend to like to be able to see them all at one go.* (Olwen, Int. 8, November 1993)

Diana felt, on the one hand, that the foundation for Ma1 skills needed to be laid early in a child's school experience. On the other hand, she expressed the belief that young children were less able to participate in open-ended work, but this

was clearly tied up with her own anxieties about being able to provide suitable activities.

> *I'm trying to give examples of where you've got directed activities, but you want to move them on from that, using perhaps some of those skills. But what if they haven't actually acquired those skills? How do you do AT1 with children who are really just starting out on their numeracy skills?* (Diana, Int. 11, 17.1.94)

She described with enthusiasm some "*self-engendered*" work which she had set in motion the previous year with slightly older children, and expressed a belief in the value of such work. Now teaching the youngest children in the school, she was unable to see how to resolve this conflict between what she saw as valuable, and what she felt the children could profitably engage in.

In contrast to these conflicts between teachers own views and a view of Ma1 as permeating through the whole of the mathematics experienced by all children, one of the three teachers to come to the school half way through the research presented a picture of a set of beliefs consensual with Ma1.

Olivia liked her pupils (Year 2) to view themselves as mathematicians, and encouraged a view of mathematicians as problem solvers who found different routes to solving their problems and enjoyed working in this way. Although, as a relatively inexperienced teacher, she was finding difficulty in translating her beliefs about mathematics and teaching mathematics into classroom practice, she knew where she wanted to go, and her practice would follow her beliefs.

> *But if they're looking at maths in a way that is actually exploration, and you're not perhaps writing down symbols and showing it in that way, then using and applying can happen at any time. In fact they are using and applying before they've got those other skills, and they can only get those skills through using and applying, I think.* (Olivia, WG2, Int. 20, October, '94)

7.2.2.2 Conflicts in common for several individuals

Some beliefs about 'Using and Applying Mathematics' were held by several teachers. These have been termed 'group beliefs' as distinct from 'individual beliefs' or 'shared beliefs'. Group beliefs have been defined as beliefs held in common by two or more members of staff, but which may not necessarily have been arrived at through discussion. In some cases these group beliefs were in conflict with ways of working which would promote the development of Ma1. For example, several teachers shared

the view that Ma1 was likely to occur in situations where children didn't realise they were doing maths - didn't see it as maths - and this seemed to be viewed as beneficial.

> Eric: ... *one of the main things, the pleasing comments you get, "Well we haven't done any maths today" after the end of the lesson, after they've actually done it. And I think that's quite an achievement, really, cos they've actually done it without realising it's maths* ... (Eric, DH, KI, Int. 16, January '94)

The beneficial effect on pupils of engaging in mathematics without realising it was described by several teachers. (The question this belief raises about the nature of what pupils **do** see as mathematics and why, cannot be discussed here but would be interesting to follow up in further research.) This belief clearly does not fit with the need to make the mathematics in a task explicit so that pupils may more easily use it in another context. Indeed, Eric himself, earlier in the interview, had stressed just this point, indicating the complexity of belief systems where conflicting beliefs are held contemporaneously.

> *There's also the value of applying knowledge, even though they perhaps don't know they've got the knowledge, but they are actually applying it, and then I think you've got to be explicit and say "Well this is what you've actually done here." And then they may actually see some sort of connection.* (Eric, DH, KI, Int. 16, January '94)

Other beliefs shared by two or more teachers related to characteristics of pupils: a 'difficult' class required a teaching approach which allowed them less decision-making, as they found organising themselves problematic.

> I talked to Ursula at lunchtime (Year 5) who described her class to me immediately as a difficult class, which she felt needed a very structured approach. She described how she was doing multiplication and division and tables in a formal way, and then gave them an investigation as a *"reward"*. They were hopeless at organising themselves for that sort of work, it appeared. (Fieldnotes 2, October '93)

Another teacher (Mary, CC, KI, Int. 12, January '94) disagreed strongly with this point of view, feeling that a teacher's own classroom organisation should be able to address these issues, ensuring that work incorporating Ma1 was an entitlement for all children.

Four teachers at Greenside expressed a belief that a concentration on the 'basics' was a necessary precursor to work with Ma1; this belief was not restricted to teachers of the youngest children in the school, but spanned the Infant-Junior age range. Liz (JC)

identified many pupil behaviours appropriate to Ma1 in her description of her class teaching with Year 6, without categorising them as such, and while also feeling that she should encourage them more. However, she also held the belief that basic number work was her first priority, with other aspects of mathematics taking second place, a belief which might operate in conflict with her feelings about Ma1.

> Liz: *Oh only because every time I look through the maths attainment I keep thinking 'you're not addressing AT1', um, I don't feel so guilty about it because there are other things that have priority. My priority for them this term really as far as maths is, is to revise, to go over things that I know they've covered and just get their understanding of the concepts a bit better sort of sorted for some of them..* (Liz, JC, Int. 4, November '93)

These examples of group beliefs indicated the need for some fairly radical accommodation of belief structures if Ma1 was to become an integral part of practice. The third belief, discussed above, focusing on a need for the learning of facts and the understanding of concepts **before** their use and application, makes problematic, for these teachers, the incorporation of the processes of Ma1 **as part of** the learning of facts and understanding of concepts. One of the two 'shared beliefs' identified in the next section (7.2.2.3) relates closely to this group belief.

7.2.2.3 Shared beliefs

Nias, Southworth and Campbell (1992), in their study of whole-school curriculum development, talked about 'shared beliefs' in terms of a degree of negotiation, or at least discussion.

> ... if 'whole schools' are perceived as being places where beliefs and purposes are shared then, of necessity, they must also be places where beliefs are openly recognised and agreed upon. We would not claim, since none of the teachers in them so claimed, that any of the schools in our study were 'whole' in the sense that all staff fully shared the same beliefs and purposes. However, each school did have explicitly expressed beliefs. (p. 27.)

The decision taken in January 1993 that 'practical and investigational maths' was an area which should be given priority in terms of whole-school development could be cited as evidence of a 'whole school' belief in the need for this development, in the terms described by Nias et al.. The arrival at this decision (through a process of open prioritising by staff of different aspects of the curriculum, itself implying 'whole school beliefs about the importance of staff participation in decision-making) did not necessarily imply that this area of maths was first priority for every teacher at the school at that time; the belief was not necessarily shared by all, but a belief made

explicit in the school development plan, and agreed by all members of staff, could be said to be shared.

The taking of this decision implied that the teachers were not satisfied with the implementation of that particular area of maths in the school. Feelings of dissatisfaction could have arisen from several viewpoints. Teachers confident in mathematics and aware of the implications of Ma1 could have become aware that other teachers did not share either their interpretations or their ability to implement Ma1 in their own classrooms. Alternatively, teachers could have become aware that their own interpretations were limited, and their ability to implement Ma1 was in need of support. A third group of teachers might have given little thought to this area of mathematics, preferring to prioritise other areas of mathematics while remaining aware of the pressure deriving from the mandatory nature of Ma1 with the introduction of the National Curriculum. As was discussed earlier, in Chapter 5, the motives of individual teachers in prioritising this area of mathematics were not clearly established.

Analysis of data collected relating to beliefs about mathematics and Ma1 revealed a dearth of what could legitimately (in terms of having been made explicit) be termed 'shared beliefs'. Only one (in addition to the one given above) has been identified as being acknowledged by a majority of the staff at the Inset Meeting (June, '94), and that was *"there are some things that you just have to teach"* - that cannot be approached through Ma1. Some teachers interpreted this as *"tell"*; it was difficult to discern how many of the teachers made this interpretation. The following extract from the notes made at this Inset meeting revealed the dilemmas of these teachers and is quoted at length. The extract also revealed the secure atmosphere which had been created for these teachers (described in Chapter 5) giving them opportunities to express insecurity and inadequacy without fear of ridicule.

> Eva [mathematics adviser] commented that if we could make normal maths teaching more investigative, it would free up the time which we normally devote to investigations; if one or twice a week we looked at our planning document and said *"Is there a more investigative way of doing this?"*
>
> Meg: *"Rather than teaching shape, and then Friday morning problem solving! Aren't there some things that you just have to do? Could you do everything through games?"*
>
> Many of the teachers at the meeting considered this an important point. Eva said that maybe she could, but she was good at maths [said in a joking manner,

intended to mean that most teachers could not expect to be able to do this themselves].

Mary came back to it. *"If you ask them to make a square, they've got to know what a square is."*

Eva: *"But how would teach about what a square was? Wouldn't you give them lots of investigative work?"*

Mary: *"I don't know."*

Lesley: *"You'd say - this is a square.!"*

Mary felt that they wouldn't just grab the idea out of the air, and Mike intervened to say that they had to know what the properties of a square were.

Eva said *"It's the word. I just use them, rather than teaching them."* She gave the example of teacher or pupil saying "I'm thinking of a shape in my head", and trying to describe it. Several teachers were nodding here, taking her point on board.

Eric felt that higher up the school where the content was getting very specific you sometimes just had to tell them - you had to put over certain amounts of knowledge. (Notes on Inset Meeting, June '94)

These extracts from fieldnotes and interviews are intended to give an indication of the types of inconsistencies and conflicts within belief structures of the teachers at Greenside School, indicating the different standpoints from which they might approach the implementation of 'Using and Applying Mathematics'. Teachers also held conflicting views in some cases, most notably about the entitlement of Ma1 for all children.

7.2.2.4 A restricted view

Teachers interviewed for the Mathematics Evaluation Project (Askew, 1996) had limited interpretations of the attainment target (see Chapter 1). Teachers at Greenside exhibited some similar interpretations, in terms of implementing Ma1 through practical work, through everyday classroom activities, through other subject areas or through investigations.

In more specific terms, two examples of a restricted view of 'Using and Applying Mathematics held by teachers at Greenside emerged from analysis of the initial interviews. The first of these related to coverage in breadth of the attainment target; the second to the type of activities regarded as appropriate contexts for Ma1.

Accompanying the 1991 version of Mathematics in the National Curriculum (DES/WO, 1991) was a poster displaying the mathematics programmes of study in strands within each of the five new attainment targets. The three strands, separated to show progression in the first attainment target (Ma1), were applications; communication; and reasoning, logic and proof. An analysis of the comments on Ma1 collected during initial interviews with teachers at Greenside School between September 1993 and February 1994 (and October-November 1994, for teachers joining the school in that term) was made. These interview comments were drawn from two subcategories entitled 'What is Ma1?' and 'What should children be doing?' in the "Attitudes to 'Using and Applying Mathematics'" developed for this research which can be found in Appendix 5d.

It should be noted in the stranding analysis that the allocation of comments to strands could not be a hard and fast procedure, since some comments could be interpreted in more than one way: for example 'giving evidence' could be an example of 'reasoning, logic and proof' or, in a different context, of 'communication'. However, despite these reservations, this analysis (see Appendix 7a, Table 7.1, Stranding analysis - 1) served a useful purpose in giving a general picture of the coverage of the three strands of Ma1.

The distribution of comments, drawn from initial interviews, between the three strands of Ma1 indicated a clear bias towards the applications strand. It was noticeable that few teachers talked about recording. Most of the comments in the communications strand were to do with children talking about their work, explaining it, and asking questions. This lack of focus on recording was confirmed from another data source. In the Inset meeting with the maths adviser (Notes on Inset Meeting, June '94), the subject of recording was discussed, with the adviser noting that she had observed that children had

been able to describe and discuss their work, but that perhaps the school needed to work on ways of recording that could be encouraged. Analysis of initial interview comments relating to Ma1 indicated a restricted view of the nature of this attainment target at the beginning of the study at Greenside. A full implementation of Ma1 would comprise elements from all three strands of the attainment target.

This bias towards the applications strand was very similar to the bias noted during the analysis of interviews from the Mathematics Evaluation Project. Following the work on the project, an analysis was made of what teachers considered to be desirable behaviours for children working with Ma1. (This project covered Key Stages 1, 2 and 3. In this comparative analysis only teachers from Key Stages 1 and 2 were included to facilitate the comparison with Greenside School. These interviews took place in March-June 1992, and it was noticeable in some interviews that teachers felt so insecure about UAM that the full range of questions could not be asked without causing distress to the interviewees.)

There was a similar preponderance in the Mathematics Evaluation Project interviews of comments relating to the applications strand. A paucity of comments relating to communication was more striking than that noted at Greenside. It must be remembered that the Greenside interviews took place 18 months to two years further on in the life of the National Curriculum, and within a different context - that of specific focus on the development of Ma1.

The similarities between the two studies suggested that the rather restricted view of the implications of 'Using and Applying Mathematics' exhibited by the teachers at Greenside (illustrated by the bias towards the applications strand) might not be a special case but might be replicated in a wider sample of primary teachers. The differences between the two studies suggested that this stranding analysis might be a fruitful avenue to pursue when trying to establish a model for development in Ma1 and this will be developed further in Chapter 8 in a discussion of the analysis of the final interviews.

The second example of a restricted view of Ma1 related to the context for its implementation. Investigations were implied by several teachers as suitable contexts simply by the way in which questions and comments about Ma1 and investigations were juxtaposed in interviews. In response to a question about Ma1 (AT1 in interviews) teachers frequently talked first about investigations.

A: *Can you describe something where you think you'd be doing it [AT1]?*

Tessa: *I don't know, you see, because I find that extremely difficult to plan for. I actually don't think that there are many investigations for the younger children to do to experience number ...* .(Tessa, IC, Int. 14, January '94)

Mary mentioned an investigation initially, but then qualified this restricted focus.

A: *... I know you were one of the people at the meeting who said they wanted more in-class support with AT1, what sort of things....?*

Mary: *We, I mean we did a couple of investigations the other day [...] one was triangular numbers ...*

But later

Mary :... *but that's actually what I really want to focus on, so, rather than just saying "Oh this is AT1 in maths" because they're doing a bit of problem work or whatever, I really want to focus on looking at exactly what AT1 is..* (Mary, CC, KI, Int. 12, January '94)

It seemed to be the received wisdom in the school, particularly among those involved at management level in the mathematics, that 'people' thought that Ma1 was just investigations, but that they should be looking for a broader context for implementation.

Meg: *I do think the other thing is that people just have this bee in their bonnet now, because, not their fault, because of the things that have filtered down about the National Curriculum, everyone is just "Oh my God, we've got to do maths investigations". But I don't really think it's quite like that, um, and so I think half of our job is to get across that it's not quite how people are perceiving it.* (Meg, WG1, Int. 10, January '94)

Resulting from this perceived need to 'do investigations' and the insecurity felt about doing them, teachers in some cases devolved the responsibility onto Eric, the Deputy Head (who gave teachers non-contact time), and asked him to 'do an investigation' when he took their class. This was sometimes justified as an activity which fitted well with being done as a 'one-off' (helpful organisationally when a class was being covered for a short time).

Valerie: *The investigative maths the Deputy Head is doing, not because I don't like doing it or anything, it's easier for him to do a set lesson, and then extend it the next time in the non-contact time, because otherwise it overlaps, and we don't get it finished or, you know, or something happens, so he continues to do that.* (Valerie, Int. 13, January '94)

Eric appeared to share this view.

> Eric: ... *I think a lot of people have asked me to do maths investigations simply because they find it a difficult area, and it's something that, it can be taught as a discrete, well I only get a slot a week with them, so they say could you do a maths investigation, and I started doing them.* (Eric, DH, KI, Int. 16. January '94)

Later in this interview, in response to a direct question about the compartmentalisation of investigations through him, Eric replied:

> *Yes, I think that's a real problem. I think it is. I think it's significant in a way that people are, well you don't know, people may be asking me to do it because they think that's a neat bit that could be tied up, that they have their non-contact time, do whatever they want, and come back and carry on with their week's work. Whereas if I was actually carrying on what they did, things may get a bit more complicated to communicate, so it's all neat and packaged. On the other hand it could be significant that they're asking me to do that because they're not too sure what they should be doing, during that session. And I think that came out on the Inset Day.* (Eric, DH, KI, Int. 16 January '94)

The change in the title for this area of development in the School Development Plan from 'practical/investigational mathematics' (1993) to 'Using and Applying Mathematics' (1994) was an attempt by Ruth, the maths co-ordinator, to counter this restricted view - a position supported by both the Headteacher in interview (who felt that she had perhaps encouraged a restricted focus by suggesting the title 'practical/investigational mathematics' herself (Int. 19, February '94)) and the curriculum and assessment co-ordinator (Mary) in a staff meeting.

In Section 7.2.2, the intention has been to paint a picture of the types of insecurities, confusions, misunderstandings and conflicts which appeared to characterise the implementation of 'Using and Applying Mathematics' among teachers at Greenside School. Teachers' own experiences of mathematics, both at school, and in their training is addressed in the next section, 7.3 The teacher as a person.

7.3 The teacher as a person

It is Fullan and Hargreaves' contention that in addition to "enabling teachers to develop, to voice and to act on their sense of purpose" (Fullan & Hargreaves, 1992, p. 5), teacher development must recognise that differences in, for example, age, stage of career and life experiences can affect responses to innovation and change. The choice of their

model as a framework for this study indicated the importance I attached to a consideration of individual teacher characteristics - an importance derived from experience of both teaching and management in primary schools.

The decision was made early in the data collection to refrain from asking personal questions of teachers but to record in transcripts what was volunteered in interviews and to record in fieldnotes what appeared to be general knowledge around the school. Their ages were thus unconfirmed but probably within the range described below. Data relating to stage of career and mathematical experiences were more accessible to direct questioning.

7.3.1 Age, stage of career and life experiences

Huberman (1992) identified several trends from research into the professional life-cycles of teachers, which recurred across studies. The phase of career entry was accompanied by the themes of survival and discovery followed by a phase of stabilisation. Stabilisation included not only a commitment to the profession, but also the reaching of a position of competence and increased satisfaction with teaching style. After this phase of stabilisation, Huberman noted some divergence between studies, but also some agreement on a phase of experimentation or diversification, bringing attempts to increase impact both in the classroom and the wider context and a feeling of readiness for new challenges. After this phase, some studies have pointed to a mid-career crisis, others to a period of 'stocktaking' (p. 125), of reflection on career so far and prospects for the future. The later stages of career brought with them a 'drawing in', a period of serenity sometimes followed by conservatism. Huberman described, from his own research, positive or negative phases at the ends of careers, sometimes taking the form of disenchantment, sometimes taking a limited focus with positive or defensive feelings attached to this focus.

These phases provide an outline structure, rather than a path which all teachers follow in the same way and at the same speed. Sikes (Sikes, Measor, & Woods, 1985) described the importance of 'critical incidents' which punctuated teachers' careers (p. 230). These critical incidents might derive from happenings in their personal or professional lives but in either case could profoundly affect careers and ways of working in the classroom. The linking of ages with this concept of life-cycle may again give a general outline, but fits less well with a profession comprised largely of women who may have to make one or several career breaks for family reasons or where, increasingly, job insecurity necessitates moving in and out of the profession.

Teachers at Greenside School spanned all phases of this life-cycle of teaching and their ages ranged from early twenties to late forties. Those newly trained and in their first term of teaching at the time of the first interviews, exhibited insecurities and anxieties typical of those struggling with survival and moving towards discovery.

> Tania: ... *but it's been a nightmare this first half of term, trying to actually get the maths done because I didn't know where to start.* (Tania, WG2, Int. 7. November '93)

Una talked about the support she was getting (and needing) from the parallel class teacher during her first term in November '94.

> Una: *Very helpful, because, you, know I might think "Oh my goodness, you know, half the class can't do this! What am I doing wrong?" And then I'll speak to him and he'll say that it's the same, so it's encouraging to realise that you're not on your own, and also to discuss what they should be doing because I think you can feel very isolated if you're on your own.* (Una, Int. 23, November '94)

Other teachers appeared to feel themselves to be at a point in their careers where they relished the challenge of greater responsibility (see also Chapter 5). These teachers had several years of experience behind them, and although their family situations differed and their experience had been gathered over varying numbers of years, they fitted with the phase of experimentation or activism described by Huberman (1992). Four teachers in particular appeared to fit this category (Eric, the Deputy Head, Mary, the curriculum and assessment co-ordinator, Tessa and Liz, Infant and Junior co-ordinators respectively); as their titles indicated, they were holding some of the major management positions in the school. Tessa described her feelings graphically:

> *I think I like to get my hands on to things and become fully involved. [...] And I can't sit back, really, I often think that perhaps if I could be satisfied with just being a classroom teacher and doing nothing else it might be better! But I obviously can't do that! So, no, I'm very happy here, it's a lovely school. I really enjoy it.* (Tessa, IC, Int. 14, January '94)

The following extract from a vignette of Mary, a key informant (returned to her for validation) also exemplified this career phase.

> Mary is an experienced and confident teacher who seems to relish a demanding and interesting post within the school. She was appointed by the Head in January 1993 following a teaching post abroad. She is a member of the Senior Management Team (Head, Deputy and curriculum and assessment co-ordinator) and is responsible for curriculum and assessment development and co-

ordination. She takes responsibility for music in the school, and plays the piano for assemblies and concerts, as well as training the choir.

She feels that it is part of her post to be an example of good practice to other teachers and thinks seriously about her own practice. She feels that she is a strong classroom teacher, and is building from a position of strength (Int 12). She participates frequently and with authority in staff meetings, but defers to others when they are leading meetings. (Vignette of Mary, CC, KI, September '95)

Personal critical incidents were apparent during the research. These not only affected the individual teachers concerned, but also other teachers in the school who were involved in giving personal and professional support. Valerie returned from maternity leave in January 1994 with the extra worry of a child who was failing to thrive and for whom frequent hospital visits were necessary. Mike had the constant responsibility of elderly parents. Linda was making the decision to go and teach abroad. These were just three examples of the sorts of personal difficulties which were overt in the school. No doubt there were many other private critical incidents which affected these teachers' lives.

There were several teachers who seemed to fit with Huberman's examples of 'disenchantment' towards the end of a career (Huberman, 1992, p. 130). From the descriptions of their feelings, it seemed that they shared a common 'critical incident' rather than experiencing their own personal ones. This 'critical incident' was the introduction of the National Curriculum. Ball and Goodson (1985) argued that the concept of career must take into account both the objective and the subjective aspects of a teacher's experience. "... there are important ways in which individual careers can be tied to wider political and economic events. In some cases particular historical 'moments' or periods assume special significance in the construction of or experience of a career" (Ball & Goodson, 1985, p. 11). Since this writing, in which Ball and Goodson cited the depression of the 1930s, the period of expansion in the 1960s and the (then current) context of cuts and falling rolls as such events or 'moments', the legislation of the late 1980s and early 1990s can be added as a 'moment' of critical importance in teachers' careers, consisting of imposed change of considerable magnitude.

Sikes (1992) discussed the meaning for experienced teachers in the 37-45 age group of imposed change, suggesting that "[i]mposed changes experienced at this time can be particularly significant because they can either be seen to offer new opportunities, or as

a criticism and denial of what one has done so far" (p. 45). There is some evidence that, in the area of mathematics and the mathematics National Curriculum, newly trained teachers were able to cope more easily with 'new' areas of mathematics (eg probability) than experienced teachers (Askew et al, 1993). Pollard and colleagues, researching the impact of the introduction of the Education Reform Act at Key Stage 1, found that there was "some evidence that younger teachers and new entrants to the profession felt more positively towards the changes being introduced and more ready to internalise them and develop their practice from them" (Pollard et al., 1994, p. 97).

The three teachers at Greenside to whom anxieties about the National Curriculum appeared to be of critical importance were all experienced teachers in their forties. It seemed that they felt that the imposition of the National Curriculum directly challenged their own preferred way of working and decreased their satisfaction with their work. Olwen expressed frustration with the pressures of content coverage across all subjects:

> *Yes, I mean, when I can look back at pre-National Curriculum days when you could follow a natural interest of your class and the thing that worries me about the National Curriculum generally is that I don't really think we're giving the children life skills that they need. [...] it's very interesting to learn about the Vikings and everything else, but it's much more important to learn how to find out our information that you might need in the future, and not just to be filled up with facts for the rest of your life ... [...] It's quite frustrating because you feel your whole philosophy of education almost has been turned upside down."*(Olwen, Int. 8, November '93)

Pollard noted similar responses among teachers. "[T]eachers had found it progressively more difficult to reconcile their belief in the value of some child choice of activity with the demands of the National Curriculum" (Pollard et al., 1994, p. 152).

Nias has written movingly about the intricacies of the work of primary teaching and the feelings of primary teachers about their work (Nias, 1989). Written just as the Education Reform Act was coming into operation she could nevertheless anticipate some of the possible implications in her conclusion. "The likely costs to primary teachers are loss of freedom (arising from the introduction of a national curriculum and national assessment) and erosion of their sense of professional integrity (should they be required to work in ways which they feel to be educationally improper)" (p. 213).

The phrases 'getting done' and 'going with the flow' used by Woods & Jeffrey (1996, p. 34) conjured up just such conflicts between an objectives led approach concentrating on

getting the prescribed task finished - the curriculum delivered and assessed - and an approach which focused more on process, and valued being able to follow children's interests and enthusiasms.

Sikes (1992) described a variety of ways in which experienced teachers coped with imposed change. The three teachers at Greenside exemplified two of these ways: Ursula and Olwen left - Ursula to take up a new career in management in a garden centre (making her hobby into her job), Olwen to teach in a private school. Carol returned to full-time teaching after two years in a job-share, 'shifting the balance' (Sikes, 1992, p. 48), giving her teaching increased commitment.

7.3.2 Experiences of mathematics

Early experiences of mathematics contribute towards the establishment of attitudes and beliefs about the teaching of mathematics and to each individual's understanding of the subject itself. Confidence or lack of confidence in teaching mathematics are not necessarily related to length of teaching experience; there was evidence of both at all stages of career among the teachers at Greenside. Many of the teachers referred in interview to their own mathematical experiences, both at school and at college, sometimes voicing strong feelings about the subject and how they had been taught.

7.3.2.1 Mathematics at school

At the beginning of the research in September 1993, only two teachers at the school had pursued maths to A level or beyond. These two teachers (Ruth and Meg) comprised the maths working group for that year. Meg felt that she had achieved success in maths by working hard at it.

> *I mean I did maths myself at A level so I enjoy maths, and the thing that I think I'm quite lucky and I'm not a mathematician in the sense that I had to struggle with it, but then I sort of worked at it and learnt it, rather than being just naturally brilliant at it, which I think helps, so I do understand when kids have problems ...* . (Meg, WG1, Int. 10, January '94)

Diana, on the other hand, felt that she was not good at maths, and that learning by rote had not given her a good understanding of the subject.

> *... I'd been taught in such a formal way, that nobody had really ever explained to me that our number system had any rhyme or reason to it, provided I learnt everything by rote. And I got through my O level by learning by rote, and I couldn't have done A level more than I could fly!* (Diana, Int. 11, January '94)

Tania had very negative feelings about maths after the age of 11. Before 11 she couldn't remember it at all. She described her relief at finding herself not alone in these feelings when she got to college. *"I think the thing that made is easier for me was the fact of realising that 95% of people in my maths group at college didn't like maths either!"* (Tania, WG2, Int. 7, November '93).

7.3.2.2 Mathematics after school

Several teachers were critical of the maths they had experienced in their training, either at college or on teaching practice. Linda found it difficult to remember what she had done.

> Linda: *I can remember all the language work I did with children on that practice, but I can't remember the maths at all, which is very odd really. But at the two schools they were following a scheme where you literally worked through each page, so really I didn't do very much!* (Linda, Int. 2, November, '93)

Karen had enjoyed her maths at college but felt that *"it was almost like going through a swift maths course as the pupil, but not as the prospective teacher"* (Karen, Int. 6, November '93). As a newly qualified teacher Tania was finding maths in the classroom difficult because it was so different from what she had done at college. *"Well at college, they basically relied on, apart from teaching basic numeracy, sort of counting on, counting back, basically they relied on the schemes, and they told us an awful lot about what different schemes did ..."* (Tania, WG2, Int. 7, November, '93).

Una, another newly qualified teacher who came new to the school in September 1994, also had negative feelings about the use to her of the mathematics input in her teacher training (Una, Int. 23, November '94). In contrast, the two teachers (Olivia and Nell) who came to the school at the same time having taken mathematics as a main subject in their training, had found that the problem-solving approach adopted at college had convinced them to work in this way in the classroom. Nell described the contrast between A level and college mathematics. *"Yes, I think, coming from A level, everything has a right answer and proper way of doing it, and to suddenly realise "Oh no, there's lots of ways I could do this!" Loads of different answers, much more open-ended and much more interesting"* (Nell, MC, Int. 21, October, '94).

7.4 Conclusion

This chapter has focused on disparity. The intention throughout has been to discourage an assumption of homogeneity among a group of teachers and encourage a focus on the heterogeneity of experience. For this reason the possible conflicts and inconsistencies in belief systems both for individuals and at a whole-school level have been drawn from the data. However it must be emphasised that during the early stages of the research, the general feeling surrounding the implementation of Ma1 was one of uncertainties rather than overt conflicts. Only by probing the data for possible conflicts have these inconsistencies and anxieties been made more explicit.

It was my impression that uncertainty did not surround other curriculum areas to the same degree. Although data to support this impression was scarce, attendance at staff discussions in a variety of working groups on the Inset Day to discuss the School Development Plan, and at staff meetings where mathematics was not the only subject under discussion, it seemed that there appeared to be more of a consensus in other areas of the curriculum about what was needed in terms of development.

There were, of course, at Greenside School many areas and issues around and upon which there was widespread agreement. The establishment of the culture of working together on development would not have been possible without this. However, as data from the initial interviews has shown, there did seem to be a lack of overtly shared beliefs about mathematics and Ma1. In terms of coming to an understanding of the mathematics development in the school, difference was evident, not only between individual teachers, but also within individual teachers' sets of beliefs about ways of working.

Chapter 8 moves the story on to consider the responses of this group of individuals to change; it follows the strategies initiated by the school to fulfil the aims of the School Development Plan and looks at teachers' reactions to these and to their views about the implementation of 'Using and Applying Mathematics' as they evolved over two years of development.

Chapter 8. The heart of the matter - responses to innovation

> If we are to take the study of change seriously by considering whether it has a positive impact on teachers and the progress of students, then we must realize in a deep way that educational change is ultimately an individual achievement. (Hopkins et al., 1994, pp. 24-25)

8.1 Introduction

In Chapter 7, the beliefs, conflicts and personal circumstances of teachers at Greenside at a particular moment in time were documented from the initial interviews. This chapter is based in the same literature but draws also on more general theories of change discussed in Chapter 2. It focuses on change over time and describes two different types of analysis - the first an on-going charting of responses to the mathematics development set in motion by the school, the mapping analysis; the second an identification of issues at a second specific point in time, the end of two years of fieldwork. Analysis of data from the final interviews with teachers feeds into the last phase of the ongoing mapping analysis, then, in the thematic analysis, focuses on factors which emerged as important influences on responses to change.

8.2 Mapping teacher change

8.2.1 The starting point

This analysis made use of several data sources used in the research over the course of two school years. The starting point for the analysis 'seeped out' gradually: from initial interviews; from comments made at meetings or in the staffroom and recorded in fieldnotes; from observation of classrooms and Inset sessions, from discussions with key informants and the headteacher (transcribed or recorded in fieldnotes). After several months of data collection it became apparent to me that a picture was emerging of some movement of individuals in response to the mathematics development initiated in April 1993 through the School Development Plan. This picture - too fragmented and diverse to be called a pattern - of a movement of staff at different times and as a result of different stimuli, required clarification and illustration.

Ideas were taken from the work of Clarke and Christie (1996) which involved longitudinal case studies over two years, looking at schools' responses to external reform (in their case, assessment reform). Five types of response were identified in their research as typical of whole-staff responses to different activities - reactive,

engaging, active, reflective, creative. In the analysis which follows, individual teachers' rather than whole-staff responses have been charted and allocated to categories, experience from this research having indicated the difficulty of establishing whole-staff views. As discussed in Chapter 7, aspects of teachers' beliefs, personal lives, careers and positions within the school appeared to be affecting, or had the potential to affect, their responses to change.

8.2.2 The mapping analysis

Teachers' responses to the development of Ma1 in their own teaching were categorised and charted over five phases of the research. These phases were described more fully in Chapter 3 and summarised in Table 3.1, which is repeated here to set the following analysis in context.

Phase of research	Research activities
1. Sept '93 - Feb '94	Familiarisation with teachers and classrooms. Initial interviews with all teachers (17). Informal meeting and interview with Headteacher. Return of transcripts for respondent validation. Observation of mathematics working group (WG) meeting (1); Infant meetings (2) and whole-staff meetings (4). Report from maths co-ordinator (MC) on meeting with LEA maths adviser. Study of: school documents and mathematics resources; school booklet; OFSTED report; mathematics curriculum document (early stages); notes on staff meetings; progress reports on School Development Plan (SDP); new SDP.
2 March '94 - May '94	Selection of key informants (KIs) (4). Observation of KIs in classroom (5 sessions). Observation in Yr2 classroom (1); mathematics WG meeting (1); Junior meetings (2). Return of observation notes for validation. Informal meeting with Head. Study of: mathematics resources; curriculum documents in preparation; school notes on meetings.

Table 3.1 Summary of research activities at Greenside School from September 1993 to December 1996

Table 3.1 contd.

Phase of research	Research activities
3. June '94 - July '94	Observation of in-class Inset sessions (6) and Inset Meeting led by LEA maths adviser. Return of Inset notes to adviser for validation. Observation of mathematics WG meeting (1). Study of: mathematics and topic-based curriculum documents in preparation; school notes on meetings; resources.
4. Sept '94 - Nov '94	Interviews with new teachers including new MC (3). Interview with outgoing MC. Observation of outgoing MC sessions in classrooms (2). Return of notes to co-ordinator for validation. Observation of KI (1). Observation of mathematics WG meetings (2); departmental meeting (1) and whole-staff meetings connected wholly or partly with mathematics (2). Two informal interviews with Headteacher. Study of: mathematics and topic-based curriculum documents; mathematics resources; school notes on meetings.
5. Dec '94 - March '95	Observation of one maths lesson in each classroom (17). Observation of mathematics WG meeting (1); departmental meetings (2) and whole-staff meetings (3). Observation notes returned to teachers for respondent validation. Two informal interviews with the Head, recorded in fieldnotes. Final interview with KI (curriculum co-ordinator). Study of: school planning documents once again under review; mathematics resources; school notes on meetings; new SDP.
6. April '95 - Dec '95	Final interviews with teachers participating in the research (14). Informal interview with MC, recorded in fieldnotes. Two informal interviews with the Head, recorded in fieldnotes. Return of vignettes to KIs for respondent validation. Study of report by MC of monitoring process at Key Stage 2

Table 3.1 Summary of research activities at Greenside School from September 1993 to December 1996 (contd.)

Five categories of engagement with the mathematics development were suggested by the data - 'sitting tight', 'feeling the need', 'going out to meet it', 'taking it into the classroom' and 'putting it all together' - to suit the context of Greenside School. These

categories, intended to be self-explanatory in title, have been taken to represent attitudes to the development of Ma1, and reflect an increasing level of engagement with its implementation (see Appendix 8 for fuller descriptions of these categories). The course of the mathematics development included certain specific activities, such as the visits of the adviser, which are mentioned as they relate to different phases of the research. The collection of a bank of materials appropriate to Ma1 continued throughout the research, with the writing of the progression occupying the maths co-ordinator and being the subject of working group, departmental and whole-staff meetings during Phases 1 to 3.

It must be stressed throughout this analysis that the allocation of teachers to categories and the charting of movement between categories has been dependent on data being available. There was more data on some teachers than on others - for example, the key informants. It is possible that some teachers could have 'moved on' had more data been available, and this was a consideration in making the decision to conduct observations with all staff in Phase 5 of the research, thus providing firmer documentation for decisions made about allocation to categories.

8.2.2.1 Phase 1

Positions were allocated to teachers from the data collected in the first interviews (see Figure 8.1). At this point the school had been working with the School Development Plan for about six months. Since it had been a collective decision to give 'practical/investigational' maths priority on the development plan, it might have been assumed that teachers could be said to be engaging with development in this area. However, this did not appear to be so in all cases. Those teachers placed in the 'sitting tight' category were those who, from the first interview and from views noted in fieldnotes, rather tended to assume that they were *"cover[ing] it on the way"*, to use the phraseology of one of the teachers interviewed for the Evaluation project (Askew et al, 1993). They did not express the need for personal development in this area. Comments such as *"Well, I mean, you're doing lots of practical maths, all the time, you're doing it in PE, you're doing it in lining up and taking the register ..."* seemed to exemplify this view of 'covering it on the way'.

Sept 1993 - Feb 1994

M'leine R				
Tania Y1				
Ursula Y5				
Mike Y5	Lesley Y2			
Olwen Y3	Karen Y3	Mary Y4 CC		
Linda Y1	Diana R	Eric DH		
Valerie Y4	Liz Y6 JC	Meg Y6 WG1/2		
Carol Y3	Tessa Y2 IC	Ruth MC		
Sitting tight	Feeling the need	Going out to meet it	Taking it into the classroom	Putting it all together

Figure 8.1. Positions allocated to teachers in Phase 1 of the research

Note: In Figures 8.1 - 8.5, Year groups are indicated after names eg. Y1-Y6. R - Reception; MC - maths co-ordinator; DH - deputy head; CC - curriculum and assessment co-ordinator; JC - Junior co-ordinator; IC - Infant co-ordinator; KI - key informant; WG1 - member of maths working group April '93 to April '94; WG2 - member of maths working group April '94 to April '95.

Teachers placed in the 'feeling the need' category gave an indication that they needed to do something about the implementation of Ma1. Comments such as *"No, we need to take more account of that in our planning"* (Lesley, Int. 3, November '93), *"... every time I look through the maths attainment I keep thinking you're not addressing AT1', um, I don't feel so guilty about it because there are other things that have priority [...] but ... no I think I should be doing it.."* (Liz, JC, Int. 4, November '93).

The four teachers placed in the 'going out to meet it' category at this period of time, were either members of the working group set up in April 1993 to facilitate the development of practical/investigational mathematics in the school (a title later changed to 'Using and Applying Mathematics' when the development entered its second year), or had given evidence of responding to the early stages of the maths development by consulting some of the activities collected together by the working group.

8.2.2.2 Phase 2

After this initial assignment of teachers to categories of reaction to the development of Ma1, data collected in the second stage of the research were consulted for indications of, and stimuli for, any change in reactions. This period included the selection and observation of four key informants and some required assessment of Ma1 by the borough. (A selection of classroom observations, annotated to exemplify both teacher and pupil behaviours appropriate to Ma1, is given in Appendix 13.) Figure 8.2 shows

that four teachers have been placed in different categories of response by this stage of the research.

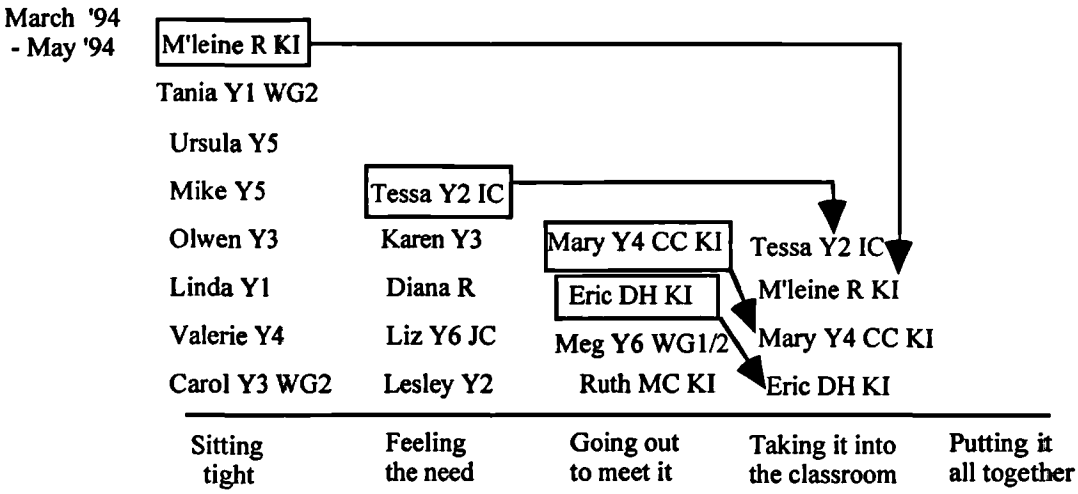

Figure 8.2. Positions allocated to teachers in Phase 2 of the research

The stimulus for Tessa (IC)'s movement to the 'taking it into the classroom' category seemed to be an assessment of Ma1 which had been requested by the advisory staff in the borough. She was keen to discuss these assessment activities in the staffroom with the maths co-ordinator and with me and volunteered that a session should be observed. The observation of her second assessment investigation (Obs. 5) revealed several of the teaching strategies and pupil behaviours appropriate to the development of Ma1. All the teachers placed in this category were actually observed in the classroom by me during an activity which incorporated Ma1 (Obs. 1, 2, 4). Observation of these activities encouraged subsequent reflection. In some cases they were using Ma1 activities in a 'bolt-on' way, as investigations considered separately to the rest of their mathematics. Other teachers were using strategies and encouraging pupil behaviours consonant with Ma1 (see Chapter 3; 3.5.3.2).

Three of the teachers identified as having moved into the category of 'taking it into the classroom' (Madeleine, Mary (CC) and Eric(DH)) had also been identified as key informants. Reflection on their teaching was probably encouraged by discussion of my classroom visits and observation of their classroom teaching may well have been a stimulus for development. Inevitably when monitoring change in an institution researchers will influence events and is important to accept this and to be aware of this. This may be viewed in a positive light as an extra source of information regarding reasons for change. It is possible, of course, that other teachers, had they been observed, could have been placed in this category. However, selection of key

informants was a reflection of their approach and of their apparent 'openness' to more process-based ways of working in mathematics.

8.2.2.3 Phase 3

Phase 3 of the research started in June 1994, with the observation of Inset sessions and the follow-up meeting conducted by the LEA mathematics adviser, in all year groups except Year 5. (A selection of Inset Notes is given in Appendix 14.) These sessions appeared to have been a stimulus for increasing involvement with Mal on the part of six members of staff (see Figure 8.3).

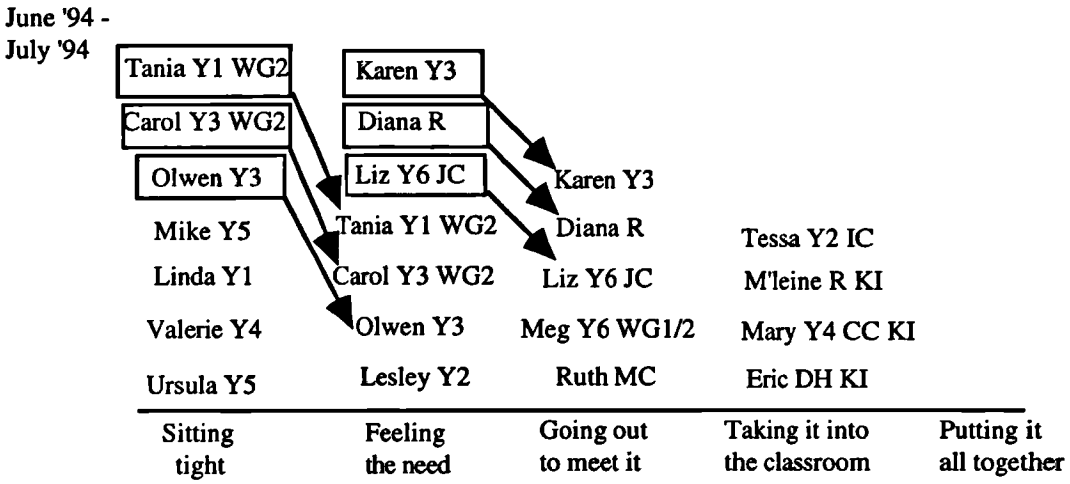

Figure 8.3. Positions allocated to teachers in Phase 3 of the research

Looking first at those teachers considered to have remained in the 'sitting tight' category: Linda's response to the Inset sessions was one of lack of real engagement with the issues involved. She did not stay to discuss the session afterwards with the adviser and her comments later in the staffroom related to the children's behaviour, rather than to any aspect of the activity (Inset Notes, Yr 1). Mike, Ursula and Valerie were not present for the Inset sessions through illness, and of these three only Mike was able to attend the whole-school Inset Meeting. Ursula has now left the school. Lack of data on these teachers has provided insufficient evidence for movement to another category.

Olwen and Carol (WG2) were clearly interested in the reactions of the Year 3 class to the adviser's activity (Inset Notes, Yr 3). They both said, separately and together, that they felt it had been a valuable activity. Carol (WG2) also volunteered that they attached too much importance to written work, did not do enough of this type of activity and needed to do more. Tania (WG2) was able to express several insecurities to the adviser after her Inset session, including her need for more suitable activities (Inset

Notes, Yr 1). These three teachers were thought to have moved to the category of 'feeling the need'.

The Inset sessions, and more particularly the whole-school Inset Meeting which followed the sessions, also appeared to have stimulated other teachers (Diana, Karen and Liz (JC)) to become more active in, and reflective upon, this area of maths development - 'going out to meet' the need for development, actively seeking work for their pupils which incorporated aspects of Ma1 (Inset Notes Yrs R, 3, 6; Notes on Inset Meeting, June '94).

8.2.2.4 Phase 4

In Phase 4 of the research (September - October 1994), the mathematics co-ordinator (Ruth, MC, KI) had no class responsibility and it had been planned that she would devote her timetable to in-class work with teachers right through the school. However, she was also to be used as the first day cover teacher in case of absence or courses. To her great disappointment, there were in the end very few days during which she could maintain her timetable. She talked at considerable length about her own reactions to the in-class work in her third interview (Int. 22, October, '94), and as a result of this interview was allocated to the 'putting it all together' category for this phase of the research. The placing of teachers in this category required some evidence of the permeation of Ma1 through the other attainment targets, and the feeling that the process skills of Ma1 were central to mathematics teaching. Ruth's choice of activities to use in other teachers' classrooms indicated increased confidence in promoting this area of mathematics, as she herself admitted. In some situations it seemed that she was working from where the class-teacher had asked her to start, and was opening out these activities in an attempt to show the other teachers how Ma1 could be integrated with the other attainment targets (Co-ordinator observation 2). In other cases she was adapting the adviser's activities for different age-groups, or in reaction to comments made by the adviser on the success or otherwise of her own activities. During this time she was asked specifically by Tania (WG2) to conduct a shared investigative activity with her in the classroom. On the basis of this, Tania was moved to the 'going out to meet it' category. Unfortunately Ruth had to cover another class on the selected day, so it never materialised.

The interview with Olivia (WG2) who came new to the school in September 1994 (Int. 20, October, '94) showed that she was already working to give the process aspects of mathematics a central role in the whole of her mathematics teaching. *"I think I develop*

an attitude for them, through the way I introduce maths, and I think that that is influenced by the requirements of attainment target 1."

Nell, another new teacher that September, and identified as the next maths co-ordinator, was less articulate about her classroom teaching (and was therefore not categorised at this point in time as 'putting it all together'), but gave a strong indication that she was confident and enthusiastic about encouraging decision-making by children (Int. 21, October, '94), and described her own view of mathematics as *"all about pattern and seeing the pattern and logic in things."*

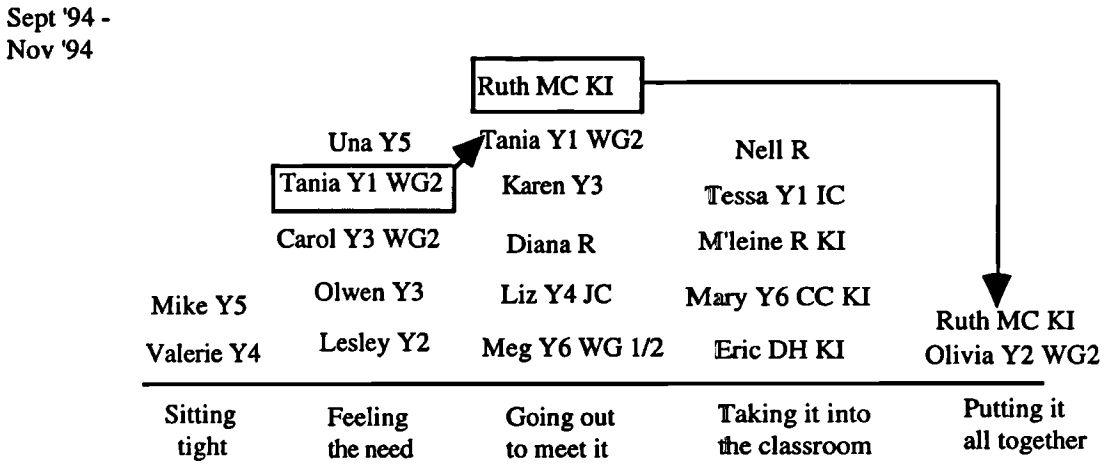

Figure 8.4. Positions allocated to teachers in Phase 4 of the research

Note: the following teachers left between phases 3 and 4 - Ursula, Linda; the following teachers came new to the school - Nell, Olivia, Una.

8.2.2.5 Phase 5

Data collection in Phase 5 of the research (December 1994 - March 1995) consisted mainly of classroom observations requested by me and conducted at the teachers' convenience. Some teachers made it plain that they weren't putting on anything special, but others had clearly thought about an activity which would evidence Ma1 to some extent. This phase of the research also took in the SDP Inset meeting in January 1995, the incorporation of specific investigative activities (a task now taken on by Nell as incoming maths co-ordinator) in the detailed planning document prepared by the school from individual subject progressions, and Infant and Junior levelling meetings on assessing Ma1 through an investigation. In Figure 8.5 all the teachers moved into the 'taking it into the classroom' category were, in my opinion, showing evidence of encouraging a variety of pupil behaviours appropriate to Ma1 and adopting specific strategies to bring this about (Obs. 10, 12, 15, 16, 19, 22) The activities chosen were, in

several cases, concerned with handling data. Liz (JC), for example, in the course of a long class discussion, created an atmosphere where pupils were eager to offer ideas; they were asked to look for flaws in the design of their own and each other's data collection and reflect on better ways. Olwen, willing to adopt a less open situation than Liz, leaving fewer decisions to the pupils, nevertheless gave them opportunities to design and criticise their own methods of recording.

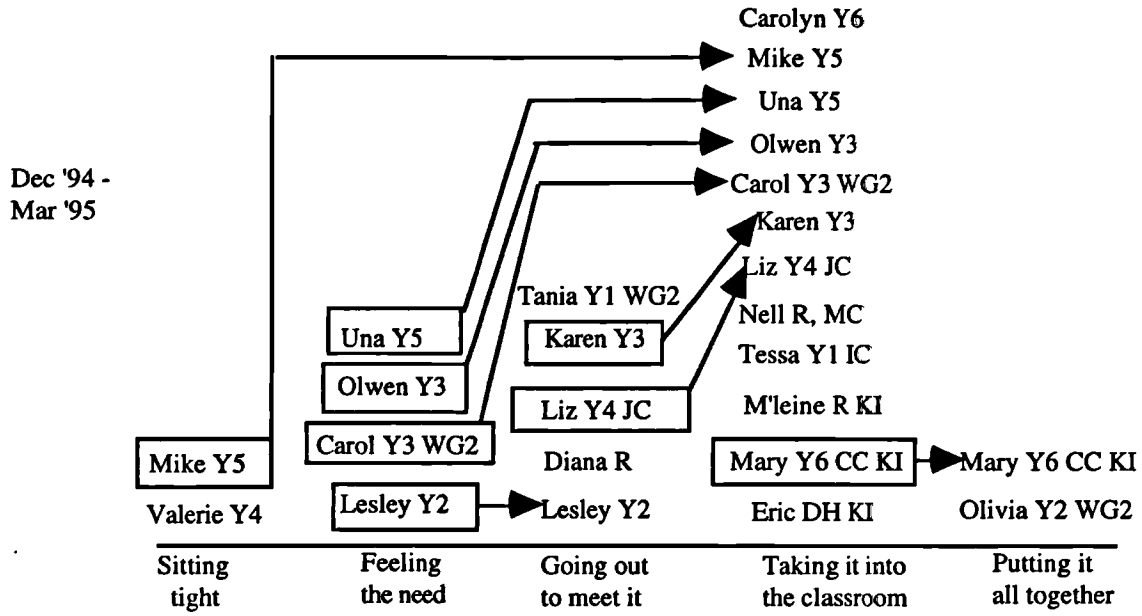

Figure 8.5. Positions allocated to teachers in Phase 5 of the research

Note: The following teachers took maternity leave in November 1994 - Ruth, Meg. Carolyn was on long term supply.

Mary (CC, KI) left Greenside School at the end of March 1995 to take up a deputy headship elsewhere. Mary's final interview (Int. 24, March '95) just prior to her leaving, has, because of its timing, been used to provide data for Phase 5 of the mapping analysis, but it also informs the analysis of the final interviews (see Section 8.3). This interview seemed to illustrate a teacher who was convinced of the desirability of incorporating the process-based aspects of Ma1 throughout her maths teaching, but who was as yet a little uncertain about creating a variety of contexts.

> Mary feels that AT1 is now part of her maths practice. It is difficult to establish quite to what extent she sees the implementation of AT1 as being through investigations, and how much she sees it permeating through all her maths teaching. At a staff meeting in January (Fieldnotes 55) she was keen to broaden the discussion from the 'using and applying mathematics' working group into a wider focus than just investigations. On the other hand, the activities in her classroom, and described by her (the circuit mornings (Int. 24,), would fall mainly into the category of investigations. However, she indicated that she was

employing different approaches in her descriptions of her daily maths activities and emphasised the importance of alternative methods of doing calculations, valuing children's individual contributions. (Vignette of Mary, September '95)

Mary was therefore allocated to the category of 'putting it all together for Phase 5 of the research. Lesley's movement resulted from the discussion in the Infant meeting to select investigations to go in the planning document (Fieldnotes 56, March '95), where she participated with considerable interest, taking ideas from others and offering examples of her own.

Figure 8.6 shows how the number of teachers assigned to each category (represented by the bars) changed over five phases of the research.

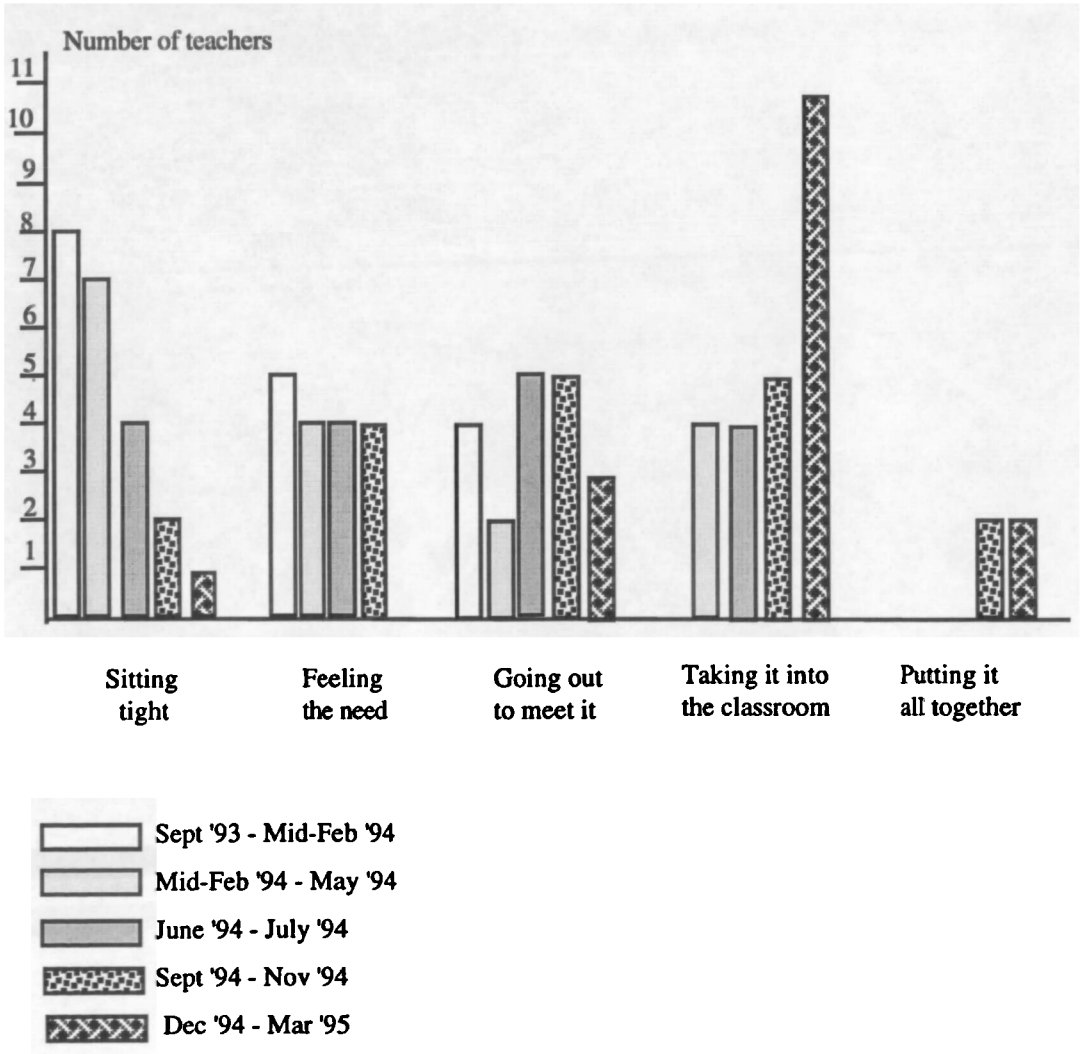

Figure 8.6. Number of teachers assigned to each category over five phases of the research

Figure 8.7 shows the positions of the group of teachers at the beginning of the research, and almost two years later.

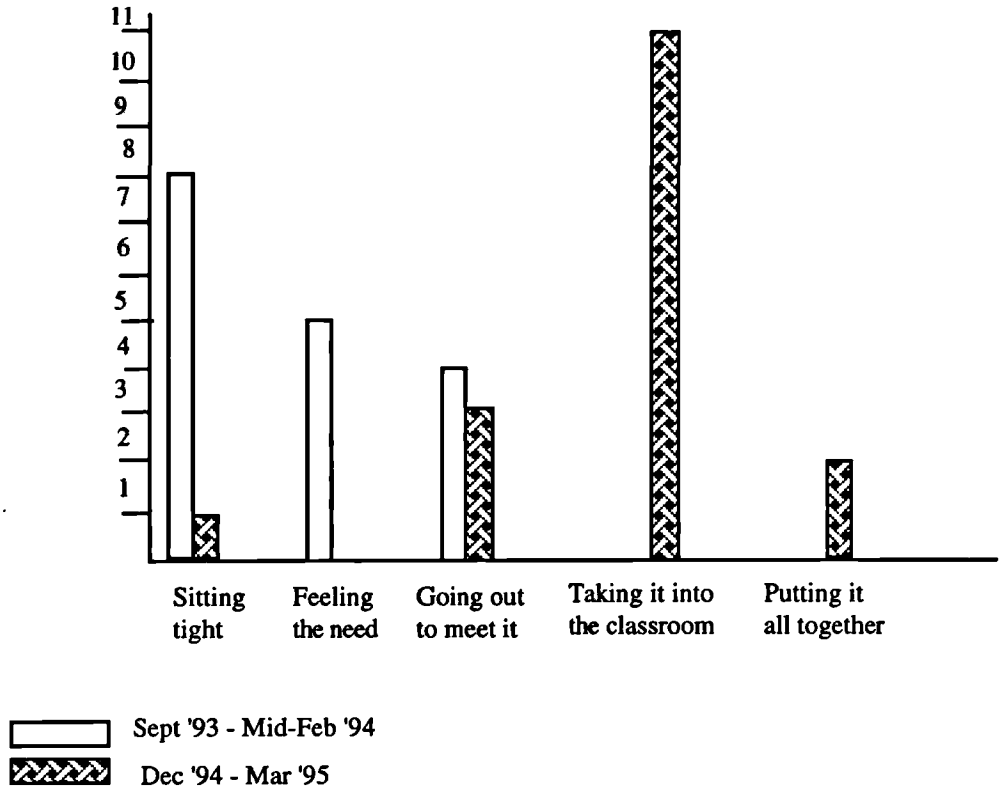

Figure 8.7 Number of teachers assigned to each category during Phase 1 and Phase 5 of the research

The 'speeding up' of adoption of innovation with increased participation by many teachers (indicated in Phase 5 of this mapping exercise) shares some similarity with the 'S' curves of diffusion of innovation described by Mort & Vincent (1954) and others (eg. Katz, 1970; Havelock, 1973) and referred to in Chapter 2 of this thesis. In the present case, however, 'taking it into the classroom' does not represent a final stage in the implementation of Ma1. Until teachers are 'putting it all together', they cannot be said to be implementing Ma1 in the manner suggested in the non-statutory guidance (DES/WO, 1989b), a stage which would represent the institutionalisation of 'Using and Applying Mathematics' in the mathematics curriculum.

8.2.3.6 Phase 6 - reporting and self-reporting

From April 1995 until the completion of the fieldwork at the end of that summer term, data collection took the form of interviews with all those teachers who were still at the school and who had been involved with the research over at least one academic year (See Chapter 3). The supply teacher who replaced Mary (CC, KI), for example, was not interviewed, nor was the Nursery teacher who took over from Ruth (MC, KI). Analysis of the final interviews is described in greater depth in section 8.3.

During Phase 6 of the research teachers reported in their final interviews that they had begun to implement the compulsory investigative activities that had been written in to the new planning document. However, since these had not been observed by me, researcher categorisation was not changed from that used in Phase 5.

As described in Chapter 3, one element of the final interviews was a request for the teachers to make a self-categorisation of their own positions at the beginning and end of their involvement in the research with respect to the five statements describing 'sitting tight', 'feeling the need', going out to meet it', 'taking it into the classroom' and 'putting it all together' (see Appendix 8). Most of the teachers seemed to relate to these descriptions easily, and quickly made some categorisation, sometimes wanting to place themselves in between two categories, or moving between two. Valerie was the only teacher who found these categories unhelpful; she was also the teacher whose self-categorisation differed most from mine. One teacher responded in writing, and one failed to respond. Figures illustrating the comparison between my categorisation and teachers' self-categorisation can be found in Appendix 16 (Figures 8.8 and 8.9).

Few teachers were willing to admit to 'sitting tight' at the beginning of the research but neither did many lay claim to be 'putting it all together' at the end of the research. On the whole, researcher and teacher classification tallied well, particularly when reporting on positions reached at the end of the research, and rarely being more than one category apart. The exercise served as a useful validation for the meaningfulness of the categories used, and an indication that researcher's and teachers' 'realities' were reasonably close to each other.

8.2.3 Some pattern in the diversity

Two phases of the research, Phases 3 and 5, saw more movement than others. The strategies in the SDP which might ostensibly have provoked this movement were the visits of the adviser (Phase 3) and the incorporation of compulsory investigative activities in the planning documents (Phase 5). Although no claim can be made that these were critical factors, both these strategies for development were cited by several teachers in the final interviews as having been helpful to them. However it is necessary to be cautious about attributing change in too simplistic a way to certain strategies or happenings. Longer term effects of, for example, the writing of the maths progression which included all attainment targets, could be seen, from the final interviews, to be starting to influence teachers' feelings about mathematics and their use of a commercial

mathematics scheme. This may therefore in the long term prove to have been instrumental in affecting, in turn, ideas about Ma1. These factors are discussed further in section 8.3 The final interviews.

In addition to looking at what the school was doing in terms of the maths development at different phases of the research, the analysis also considered different types and speed of movement shared by more than one teacher. The two teachers categorised by me as non-movers (Linda and Valerie) had both been affected by personal critical incidents during the course of the research (see Chapter 7). Other types of movement were considered ('steady movers', 'single jumpers') but there appeared to be no additional factors common to these groups of teachers (eg. Junior/Infant, age, stage of career).

The characteristic of 'early adoption' of innovation (Havelock, 1973) was then considered. Of the four teachers who could be placed in this category (Tessa (IC), Madeleine (KI), Eric (DH, KI), Mary, CC, KI)), three held senior positions of responsibility in the school and were mentioned in Chapter 7 as having reached a stage of 'experimentation/activism' (Huberman, 1992, p. 124). In Havelock's terminology these three teachers could be said to hold 'central' rather than 'peripheral' positions (Havelock, 1973, p. 159) in their own particular network. However any suggestions of causality are dubious. Did they hold these positions because of their responses to innovation, or were their responses to innovation a factor of holding central positions? Another interesting characteristic shared by all four of the 'early adopters' was that they all appeared to be confident classroom practitioners generally. This confidence did not extend, in Madeleine's case at any rate, to working group or whole-school settings, nor did it necessarily apply to the teaching of mathematics. None of these teachers expressed any particular confidence in that area of the curriculum. As was noted in Chapter 2, innovation involves risk-taking; it may be that these teachers were more prepared to take risks, secure in the knowledge that they could control their class even in more experimental situations.

Among the later adopters were two (Olwen and Carol (WG2)) of the teachers already identified as having reached the stage of conservatism or disengagement. Others among the later adopters were NQTs (newly qualified teachers) when the study began (Karen, Tania (WG2)) and were still at the survival and discovery stage.

Although some pattern was discernible in this mapping analysis of responses to the strategies adopted by the school to facilitate the development of Ma1, the over-riding impression was one of individuals responding in different ways at different times to

different stimuli. Apart from those teachers mentioned above whose reactions to the development did seem to respond to being grouped with others, there were other teachers who were neither at the beginning nor the end of their careers, who were relatively experienced but whose response to the innovation appeared fairly marginal.

Mary's story (CC, KI) provides a cautionary note about inflexible categorisations. During the first year of the research she had chosen the development of Ma1 as the subject for her own personal appraisal; she took a positive view of the need for development in this area and encouraged other teachers to become involved. She was identified as an 'early adopter'. During the second year of the research, however, her personal circumstances changed and demanded more of her attention and energy; she was applying for promotion elsewhere and in addition she suffered an accident which kept her away from school for almost half a term. She readily admitted (in the interview just before she left the school in March 1995, which served as her final interview) that these factors had severely curtailed the making of similar progress to that which she felt she had made over the first year.

> *You see I don't know if other teachers would be prepared to put in as much as I've done myself with it, and I can understand that they wouldn't and, **if I was thinking about it this year, then I probably wouldn't do it because I haven't got time to do it.*** (Mary, CC, KI, Int. 24, March '95) (My emphasis)

8.3 The final interviews

8.3.1 Framework for the interviews

The final interviews took place in May, June and July of 1995, five or six terms after the initial interviews for most of the teachers. Mary (CC, KI) who left at Easter of that year was one exception to this, as were Olivia (WG2), Nell (MC) and Una who joined the staff in September 1994. Ruth (MC, KI) was interviewed in October 1994. Meg (WG1) was interviewed informally (recorded in fieldnotes) at the same point in time before she also left to take maternity leave.

As described in Chapter 3 (3.5.2.2), these interviews took a different form from the first interviews which were loosely structured and wide-ranging. Teachers were asked to comment on whether they still held beliefs and views expressed earlier in the research, and about whether they thought other teachers might share these views. They were then all asked the same set of questions relating specifically to Ma1 in terms of their perceptions of individual and whole-school progress and their intentions for Ma1 in

their own classrooms (see Appendix 9 for the full set of questions). The teachers were asked in each case to describe their positions viz a viz the categorisations used in the mapping analysis (see Section 8.2 above and Appendix 8). Teachers were pressed for time at this stage of the summer term and the interviews were completed in 30 to 40 minutes. Two teachers were asked to respond in writing to the three aspects of the interview. One teacher (Lesley) was unable to do this, and is therefore not part of the analysis that follows. (A selection of final interviews (summarised) is given in Appendix 10.)

8.3.2 Thematic analysis - emerging issues

These final interviews were summarised from tape recordings rather than transcribed, under the headings of the questions asked of all the teachers. The summaries were then analysed in a holistic, or thematic way. Several themes or issues appeared to be common to the responses of several teachers. These were then developed and compared with the initial interviews to establish whether there had been change over time.

Ownership of Ma1	Strategies for change	Factors inhibiting change
The 'feel' of Ma1	Pressure and support	Pressure of statutory assessment
The vocabulary of Ma1	Professional collaboration	Isolation in the classroom
Changing beliefs, changing practice	Individual work	
	The provision of resources	
	Outside input	

Table 8.1 Thematic analysis of final interviews - emerging issues

8.3.3 Ownership of Ma1

The word 'ownership' has been overused in recent writing about the National Curriculum and is regarded as a somewhat meaningless 'buzz' word by many teachers. However, it has a succinctness which encapsulates both epistemological and affective aspects, and describes well the status of teachers' approaches to the National Curriculum documents, as discussed in the report on the Evaluation of the implementation of National Curriculum Mathematics (Askew et al., 1993).

> Bowe, Ball and Gold (1992) discuss the translation of educational policy into a working document through the legislative process, and used Roland Barthes' division of literature into that which gives the reader a contributory role (which he refers to as 'writerly'), and that which gives the reader no more of a role than acceptance or rejection of the text (which he refers to as 'readerly'). [...] Until the introduction of the National Curriculum, teachers had been working from what they knew and what they were familiar with. Faced with the legal requirement of the National Curriculum they had to reconcile what they knew with what was new. The response of many teachers, at least initially, was to feel that what they knew had been devalued, and therefore any attempt to interpret the new in the light of their own experience seemed an exercise with little credibility. These teachers were more likely to interpret the text as requiring a 'readerly' response, as something to 'deliver' in its entirety, and they clung fiercely to the security of following the documents step by step.
>
> For other teachers, the text may have been seen as requiring a 'writerly' response, but the process of responding in this way may have seemed beyond their reach, particularly if the culture of the school in which they were working was not sympathetic to that view. Making sense of any new text requires time and effort in becoming familiar enough with it to attempt any sort of critical exercise or translate it into something which fits more comfortably with what is known. (Askew et al, 1993, p. 69)

The word 'ownership' is used in the following sections to describe teachers' familiarity with the text of Ma1, their ability understand and work with it and the feelings they exhibit towards this aspect of the mathematics curriculum.

8.3.3.1 The 'feel' of Ma1

By the time of the final interviews, for certain teachers, Ma1 now had a different 'feel' about it. There was a sense of a movement from something external which had to be drawn in, to something internal which had to be developed. One teacher described the need to get better at identifying where else in maths Ma1 was occurring, but felt she had already made progress with this, *"Yes, that's much easier now, because you're not thinking of AT1 in a lonely context"* (Tessa, IC, Int. 27, May '95). Other teachers described themselves as becoming more able to recognise situations where they could develop Ma1 when working with the other attainment targets, even if they hadn't specifically planned for this. Madeleine described how she could *"see more possibilities of doing AT1"* (Madeleine, KI, Int. 37, July '95).

Words used to describe Ma1 were of a different character in these later interviews from those used in the initial interviews. It was no longer a *"real bug-bear"* or *"ghastly"*. The words *"difficult"* and *"difficulty"* had cropped up again and again in the initial interviews in relation to Ma1. Quite apart from expressions of lack of confidence in mathematics generally at the beginning of the research, teachers felt that Ma1 was difficult to teach, difficult to assess, difficult to plan for. It was difficult to provide

open-ended activities, and difficult to ask open-ended questions. Uncertainty was apparent. Teachers 'didn't know' what Ma1 involved, 'weren't sure' whether they understood the requirements in the document.

By the final interviews the feeling of intimidation had generally gone. Teachers talked in terms of Ma1 being *"not as frightening as it used to be"*, of being *"not so afraid of it"*, of feeling *"more confident"*.

8.3.3.2 The vocabulary of Ma1 - return to the stranding analysis

Ownership needs familiarity before it can flourish. The teachers groups working on issues of progression the mathematics Order for the Mathematics Evaluation Project (1991-93), were, at the end of two years, only just beginning to feel free enough and familiar enough with the Order to be able to work with it to fit with their needs, rather than regarding it as set in stone (Prestage, 1996). There were some differences between the beginning and end of the current research in terms of the Greenside teachers' familiarity with the language of Ma1, but on the whole this was a familiarity which was only just beginning for most teachers.

The stranding analysis (see Chapter 7; 7.2.2.4), focused on the vocabulary of the document and was developed to incorporate input from the final interviews (see Appendix 7b, Table 7.2, Stranding analysis - 2). This analysis illustrated a development in teachers' familiarity with vocabulary of the attainment target. On the whole there was a greater degree of specificity in the use of language related to Ma1 in the final interviews, as opposed to the initial interviews, although there were few teachers who used a wide variety of specific terms from the Order. Most talked in more general terms. Even after two years teachers were still finding it difficult to define what they wanted to encourage in the classroom, and what they were looking for in assessment beyond a fairly narrow range of skills (with a few exceptions to whom the attainment target was already very familiar).

There was an increase in the number of teachers mentioning children using a variety of approaches and deciding on the mathematics for themselves. Two teachers mentioned checking results, whereas none had volunteered this in the first interviews. More teachers talked about children being systematic, and testing their theories out. Three teachers talked in the second interview about children planning their work (designing a mathematical task), deciding for themselves the order in which they should do things. Several teachers focused on recording as something they were trying to encourage, describing pupils developing systematic recording strategies.

In addition to these views which were linked closely to the actual vocabulary of the attainment target, there were many other, less specific statements which might nevertheless be considered as part of Ma1. Children should be *"developing their own ways of recording", "building on other pupils' ideas", "learning to think for themselves", "learning to think mathematically", "developing logical ways of questioning", "applying what they knew to new situations", "seeing possibilities".* One teacher described herself as being keen to encourage *"a feeling of excitement about mathematics",* an idea of mathematics as *"useful, as being part of living".*

Teachers at Greenside were slowly building up their familiarity with 'Using and Applying Mathematics' - a necessary pre-requisite to experiencing the beginnings of feelings of ownership. They were less apprehensive, more prepared to talk to each other using the language, words and phrases which could be considered analogous to the vocabulary of Ma1, describing a spread of pupil behaviours which they wanted to encourage from across all three strands of the attainment target (applications; communication; reasoning logic and proof), with a lessened emphasis on the applications strand.

8.3.3.3 Changing beliefs , changing practice

Teachers views appeared to have changed to some extent over the course of the two years, most significantly on issues which might have affected the entitlement for all children to participate in activities incorporating Ma1. These changes in beliefs were made apparent through teachers' reactions to being presented with earlier comments about what they had thought Ma1 was, or what children should be doing if Ma1 was to be incorporated in their mathematics teaching.

'Using and Applying Mathematics' was no longer seen to the same extent as the province of the higher-attaining older child; several teachers now placed the responsibility squarely on the teacher to make adequate provision, as Mary (CC, KI) had done in her initial interview (Int. 12, October '93). *"I think you've got to think about your organisation in the class and make sure they they're* [lower attaining pupils] *perhaps teamed up with children who are going to, not lead them exactly, but support them"* (Liz, JC, Int. 25, May '95). The teacher's role was also emphasised by Madeleine. Reflection had led her to the realisation that Ma1 was a *"day after day after day"* commitment - not something which happened incidentally in one's maths teaching, but something which had to be carefully planned for and thought about. A change in her approach, which demanded more from children in terms of independence of thought

and action, more decision-making, more questioning, had been the result of this reflection (Madeleine, KI, Int. 37, July '95).

Liz (JC) no longer thought that Ma1 had to be *"practical"*. She had been thinking then about *"getting out the cubes"*, she said. She was also clearer in her own mind about the need to make appropriate provision both for children to find their own ways, and for the teacher to direct and guide, without instructing.

Olwen did not feel so overborne by content and felt she had developed an awareness of when work involving Ma1 was going on, even if not specifically planned for. Several teachers talked about being more aware of links with other attainment targets in maths. However, there were also feelings that Ma1 had to be planned for; strategies had to be taught, ways of recording had to be exemplified. Many teachers no longer thought of Ma1 primarily in terms of investigations to be added on to the rest of mathematics, although they were aware that this was how it had been thought of in the past.

Tessa (IC) was still preoccupied with her belief about 'knowing' coming before 'using and applying', although she was now incorporating investigative activities regularly into her classroom work and reflecting upon the teacher's role in these activities. She wanted children to think, to challenge themselves, to find different solutions, to realise that there could be several answers to a problem. *"Actually what I want them to do is to stop their thinking being in one line, and to spread their thinking out"* (Tessa, IC, Int. 27, May '95).

The seeds of Ma1 had to be sown in the early years of schooling; Madeleine saw this as one of her main aims in the Reception class . However, *"organising themselves"* at that age was, she felt, *"the icing on the cake"* (Madeleine, KI, Int. 37, July '95).

In terms of implementation in the classroom, there were indications of a greater flexibility following increased confidence. Tania felt that, having thought of an activity to do, actually implementing it was far less rigid - *"I'm not expecting them to do things my way"* (Tania, WG2, Int. 28, June '95). Two teachers new to teaching (Karen and Una) described themselves as coming to terms with coping with the noise level. They had both mentioned anxieties about this in their first interviews, indicating that control was harder to maintain when children were working collaboratively, talking about their work and making more decisions themselves.

> Una: *I've come to terms with it now so I'm much more happy now about having a lesson that is more investigation based so they are going to be making more*

noise, now that I know they can do it and they are actually working, I think that's what it is. (Una, Int. 29, June '95)

Karen described how, in the last year, she had felt more confident in allowing more mess, noise and freedom if *"decent maths"* was going on.

As outlined above, teachers described changes in their views in response to seeing what they had said previously. They also described changes in their practice. Some of these changes have been noted and documented by me. Some may remain in the domain of teacher perception. It is likely that elements of the mathematics development influenced these changes, perceived or documented. In the final interviews, some elements were identified by the teachers as having been particularly useful to them. These are discussed in the next section.

8.3.4 Strategies for change

8.3.4.1 Pressure and support

Almost all teachers expressed positive feelings about the strategy of writing investigative activities into the curriculum planning document. Their comments illustrated the importance of both pressure and support, discussed by Fullan and Hargreaves (1992a) (see Chapter 2). There was a feeling that *"having to do it"* was important and there was support to help you to do this. You knew you were doing something, even if it was only a start.

Tessa: ... *because you might slip back, and think you can't think of anything, but it's there. You can always think of your own in addition.* (Tessa, IC, Int. 27, May '95)

Diana: ... *we're all better for a little prod, particularly when so many things have to be fitted in.* (Diana, Int. 31, June '95)

The levelling activity, when all teachers in a department conducted the same investigation and then compared children's work, was another example of this combination of pressure and support. This was a compulsory activity and although in some instances not considered an appropriate one (for particular year groups or pupils), there was support from colleagues in interpreting the results.

Mary: *But as I say, the investigations are included in the document and so people will have to do that, and even if there's a levelling meeting once a year, it will mean that people actually do an investigation properly and talk to each other about it in their department* ... . (Mary, CC, KI, Int. 24, March '95)

The maths progression, so carefully prepared by Ruth (MC, KI) in the previous year, was cited as a source of support by several teachers. Liz (JC) described how she was now using the progression for her mathematics planning, rather than going first to the scheme - perhaps moving from 'scheme-driven' to scheme-assisted (Millett & Johnson, p. 59) planning.

> *... and you've always got a book that you can open at a page, and I think before we had all the planning there was a danger that you just opened the book at a page you felt comfortable with, and you didn't stretch children sufficiently.* (Liz, JC, Int. 25, May '95)

Several teachers talked about their use of Peak mathematics in the first interviews when discussing mathematics generally; nobody mentioned it as a source of activities in the second interviews when asked about Ma1 in particular. Perhaps this was in itself significant.

8.3.4.2 Professional collaboration

The identification of Ma1 as an area of focus seems to have been the catalyst for increased professional collaboration through discussions at a variety of levels. This talk was valued by several teachers, whether they had been a member of the maths working party or not. Ma1 was identified as being more talked about within the school than in the past.

> Mary: *Since we've had this levelling meeting, people are more prepared to talk about it, so I think there's a lot more discussion going on, not necessarily formally but informally, and people are just more aware of it, and I think that will help, I mean it's the awareness that's the starting block and then you can lead on from there.* (Mary, CC, KI, Int. 24, March '95)

Teachers were more willing to discuss issues concerned particularly with its assessment, and were more prepared to share ideas and suggestions. Some teachers felt that this was now happening spontaneously; others had only noticed it in meetings set up for the purpose. Teachers also described occasions where they had been helped by other teachers, or had given advice to others, specifically about this area of maths. Maths as a focus of displays and assemblies was mentioned as something which was on the increase.

Professional collaboration does not take place in a vacuum. Careful attention to management structures and the support needed for working in a collaborative way are needed to provide an environment in which collaboration can flourish. Greenside's

system of groups of different sizes and with different functions seemed to provide both the opportunity and the support for teachers to admit difficulties without fear of ridicule or disapproval and to try to make decisions about how to solve them.

8.3.4.3 Individual work

Several teachers described individual initiatives. Mary (IC, KI)'s own decision to focus on this area of mathematics for her personal appraisal had resulted in what she felt to be increased progress towards its permeation through her maths teaching. However she acknowledged that this concentration had its 'downside' in that the prioritising of one area of the curriculum necessarily meant a reduction in time and energy spent on others. It had to be given top priority if real progress was to be made. Madeleine felt that the fact of including Ma1 as an area of focus on the School Development Plan was enough to make her devote particular attention to it. *"Once you've highlighted something and apparatus and things have been provided for you to do it [...] and you're aware that you're focusing on it, I think that's enough - that was enough for me anyway"* (Madeleine, KI, Int. 37, July '95). Meg (WG1/2), on the other hand, felt that change had resulted from a dissatisfaction with her previous year's maths teaching.

> As far as personal change was concerned, she was now highlighting AT1 in her planning. She said this was really a response to a new class and a determination to get back to teaching maths how she really wanted to do it, rather than a response to the whole-school initiative. (Fieldnotes 46, October '94)

Olivia (WG2), coming new to the school in September 1994 to take a much younger class of pupils than her one year of teaching experience had provided, was making her own personal efforts to integrate Ma1 throughout her maths teaching. Working from a very different starting point to most of the other teachers, she described progress made during this final interview as more a matter of *"just finding my feet in a new school, really, and relaxing in my job "* (Olivia, WG2, Int. 33, June '95).

8.3.4.4 The provision of resources

Improved resources, including the file of investigational activities, were mentioned by most teachers in the final interviews as being helpful to them. They recognised the hard work that had gone in to the building up of a more appropriate resource base for Ma1 and were beginning to use the activities to supplement the investigations written into the curriculum planning document. However, there was a distinct sense of these activities being seen in a 'bolt-on' way, as evidence that they were doing something about Ma1, rather than as an encouragement to integrate the activities into the rest of their mathematics teaching, although one or two teachers mentioned how they were

beginning to see opportunities for investigative work when focusing on the other attainment targets.

8.3.4.5 Outside input

The visits from the LEA adviser were mentioned in one case as being *"completely inspirational"*, and in others with great enthusiasm. One teacher described how the adviser seemed to have ideas *"dripping out of her, almost"*. However, teachers found it hard to keep up the momentum after the visits. The results were sometimes not long lasting. Her advice on the inclusion of investigative activities in the topic planning document had, however, been taken and implemented by both Ruth and Nell as mathematics co-ordinators.

In addition to input from the adviser, inspirational mentors seem to have played an important part in the maths development of two teachers who had taught alongside gifted colleagues in other schools, giving them a goal towards which to work in the development of Ma1.

> Mary: *Our deputy was a superb mathematician, brilliant teacher, brilliant with the children, and he was one of those people who could come in and take a maths lesson, and just take it, to all sorts of levels from one bit of paper, and I would just, I mean I wouldn't have known where to start. I'm also going to get in contact with him, he's a head [..] now.* (Mary, CC, KI, Int. 12, January 1994)

> Olivia: *He's just one of these people who just loves maths, loves thinking about maths, loves doing maths with children, and has the most brilliant ideas from nothing. And he was in the classroom next door to me, um, so I would always ask him for ideas, and share ideas, or he would say [...] "Oh I noticed you were doing this. How are you going to develop that?" And perhaps I wouldn't know, and he would say. "Well perhaps think about doing this."* (Olivia, WG2, Int. 20, October, '94)

My presence in the school as a researcher was commented upon by several teachers as having been instrumental in making them reflect more on Ma1 and work harder at trying to understand it; other teachers felt that the whole profile of the mathematics focus had been raised. My observations, annotated and returned to teachers for comment, had clearly proved of interest in some cases, although few specific comments were made about the teaching strategies or pupil behaviours which had been drawn out of these documents.

8.3.5 Factors inhibiting change

As was seen in Chapter 7, based on data from the first interviews, the pressure of the introduction of the National Curriculum was perceived by some teachers to inhibit working in ways which would more easily accommodate the integration of Ma1 with the rest of mathematics. In the final interviews only one teacher specifically mentioned this pressure as a constraint. Two other factors which might inhibit change did surface, however, and are considered below.

8.3.5.1 Pressure of statutory assessment

Several teachers mentioned the pressure of statutory assessment (SATs), and feeling accountable for the children's ability to undertake and understand the statutory tasks. Sometimes this was in terms of preparation for the tasks and related to the need to make sure that children were familiar with traditional layout and forms used in the test. More time might have to be devoted this than would otherwise have been considered valuable by those teachers who also valued and encouraged children's own methods of recording what they had done.

At the time of the second interviews the results of the first official run of Key Stage 2 SATs were giving concern in the school. A preponderance of pupils at Level 3 was a source of anxiety, particularly as the results were below teacher assessments, and closer analysis of the difficulties pupils were experiencing with the tests revealed that they were unable to respond to the variety of ways in which problems were presented. In her interview, Liz (JC) returned to the dilemma of inadequate levels in the basic skills on the one hand, and the need for pupils to be more competent and independent on the other hand. She did feel, however, that the basic skills were now being approached in a more practical and investigative way.

8.3.5.2 Isolation in the classroom

In the final interviews, the teachers were asked not only to respond to their own previous comments, but also to indicate whether they thought that other teachers in the school shared their views. It was striking that very few teachers were prepared to voice opinions about other teachers' beliefs, beyond hazarding a 'probably' or 'perhaps'. This request in the interviews led to explanations for this lack of knowledge in terms of being restricted by being confined to their own classroom, and not having the time or the opportunity to see much of what other teachers were doing.

Diana: *We don't get enough chance to discuss these kinds of issues. When we get together we're planning what we're going to do next - short term plans, long term plans ... .* (Diana, Int. 31, June '95)

Some teachers mentioned more general ways of finding out about the practice of colleagues, such as through displays or assemblies, and some mentioned contact with another teacher, usually their year group colleague, but the general feeling was one of ignorance rather regretted. The new maths co-ordinator, Nell, felt that she was not sufficiently aware of other teachers' thinking, especially at Key Stage 2, and indicated that she was keen to encourage more maths displays so that more practice could be shared. In Chapter 6 the regret expressed by Ruth, the previous maths co-ordinator, in describing her (unavoidable, she felt) lack of awareness of what other teachers were doing, was discussed. This was another example of the strength of feeling that was emerging from the Greenside staff as a whole about their relative isolation in the classroom, with contacts with other teachers constrained by the practicalities of organising and planning work for their own class. It was in this context that the levelling meeting (first described in Chapter 4) was considered to have such value, in that it required teachers to talk about a specific investigation that they had all undertaken, thus providing opportunities for an exchange of ideas about practice and a forum for the admission of difficulties.

It was interesting that, in her initial interview (Int. 2, November '93), Linda, a relatively inexperienced teacher, had expressed a keen desire to be involved in team teaching so that she could gain from the experience of seeing other people teach and have the opportunity to share practice.

Closely linked to these feelings of isolation in the classroom, with little opportunity for teachers to discuss and reflect with other teachers, was a comment made by one teacher in the final interviews which related specifically to mathematics.

Liz: *I don't talk to people about maths very often.*

A: *Is that you, particularly, or everybody?*

Liz: *I think everybody. I think we all just get on with it because we've got the textbooks* .

Although this point was only mentioned by one teacher and could therefore not be considered as a major theme running through these interviews, it gives an interesting additional insight into reasons for lack of discussion of mathematics.

8.4 Conclusion

The analysis described in this chapter has travelled alongside the teachers during five phases of the research, and paused with them to take stock during the sixth and final phase. In Chapter 7, individual beliefs, characteristics and personal circumstances were emphasised; despite a whole-school decision to initiate development in the area of 'Using and Applying Mathematics', shared beliefs were rare and teachers were at very different starting points as they set out on the journey to which they had ostensibly committed themselves.

The mapping analysis (Section 8.2.2) reinforced the feeling of individuals moving at different paces from different starting points. Some communalities have been identified. Those teachers who responded more rapidly to innovation were confident practitioners generally, three out of four holding major positions of responsibility in the school. However, not every confident practitioner began to take this particular change on board at an early stage. Several teachers appeared to respond to the same stimulus activity; the visits of the adviser appeared to have acted as a catalyst for some teachers to reflect on their practice and attempt to incorporate Ma1 into their teaching to a greater extent, but others seemed to have taken little from these visits and to have engaged only marginally with them. Some teachers worked to their own individual targets, sometimes with the recent influence of skilled colleagues to spur them on.

However individual the starting points and the progress, the final interviews did identify some points of concurrence, both positively in relation to strategies employed which were well received, and negatively in relation to factors which might stand in the way of development. The combination of pressure and support brought about by the strategy of incorporating investigative activities into the school planning document, and then requiring a discussion of one of these activities, appeared to have been almost universally useful, as had the increased professional collaboration which the levelling discussion had produced. Anxieties about statutory assessment were a potential impediment to the introduction of change in practice, as were some of the beliefs about mathematics and its teaching which had remained unchanged throughout the two years of development. The teachers clearly regretted their degree of isolation in the classroom. The solitary nature of teaching as an activity has been frequently documented (eg. Pollard et al, 1994). Fullan and Hargreaves (1992b) describe the position comprehensively, but succinctly:

> The problem of isolation is a deep-seated one. Architecture often supports it. The timetable reinforces it. Overload sustains it. History legitimates it. (p. 12)

The disappointment of the first maths co-ordinator, Ruth (MC, KI) in the lack of progress in the development of work incorporating 'Using and Applying Mathematics' that she had identified before she left to take maternity leave in October 1994 was not born out at this later point in time by the perceptions of the teachers expressed in the final interviews. Almost without exception they felt that they had made progress individually (Carol, WG2, uniquely, did not feel this, describing her role in the job-share as hampering progress), and that the school as a whole had moved on, although Eric, the Deputy Head, entered a note of caution.

> Eric: *It has moved on in that it's higher on the agenda, it's more high profile and I think, although I wouldn't be able to say this, I believe it's being done more. But whether it's moved on in terms of quality I think remains to be seen and I think will be part of our monitoring exercise ...* . (Eric, DH, KI, Int. 38, July '95)

The teachers talked about increased confidence, seeing more opportunities for Ma1, coming to a better understanding of what was required for its implementation. It appeared that Ruth (MC, KI) had sown the seeds for development even though she did not see the fruits before she left. Her successor in the post (Nell, MC) has continued the work which Ruth began, with the added advantage of the establishment of a monitoring role resourced by non-contact time to work alongside other teachers in the classroom.

The perceptions of progress identified by individual teachers in the final interviews fitted with those that I had made during the course of the case-study. In both cases, progress was regarded as limited. Teachers were more familiar with the attainment target and were beginning, in my opinion, to achieve ownership of it, but there was a long way to go before engaging in the occasional compulsory investigative activity would develop into a teaching of mathematics where Ma1 permeated the mathematics curriculum. None of the teachers at Greenside felt that they had reached the end of the road - all felt the need to pursue development in this area - but several did feel that there was no need for a whole-school focus any more. They had *"done that"*.

Teachers' beliefs appeared to have changed to some extent, particularly where all children's entitlement to participate in mathematics incorporating Ma1 was concerned. However, the impression remained with me that the full implications of the implementation of 'Using and Applying Mathematics' were never either fully discussed or fully understood, and it was likely that the majority of these teachers might remain at the stage of 'taking it into the classroom' without realising quite what 'putting it all together' entailed. Commitment to this maths development on behalf of the

headteacher, the management at different levels, and many members of staff could not be said to be lacking; and this commitment was set to continue with the development of a monitoring role for the co-ordinator.

The feeling that the depths of the attainment target had not been 'plumbed' ('bounded' collaboration, Fullan & Hargreaves, 1992b pp. 74/5) was expressed by Olivia (WG2) at one of the working group meetings, although the issue was not discussed further. It is quite possible, however, that any more intensive development activity would have been inappropriate for the majority of these teachers at this particular time. Olivia (WG2) and Nell (MC) had been able to develop their ideas through teacher training that encouraged a problem-solving view of mathematics in tune with the aims of Ma1. They also had the subject knowledge of mathematics study beyond A level to support them.

There were significant developments at Greenside, as revealed in the observations, in small areas of the attainment target; for example in the encouragement and development of children's own methods of calculation and recording. It may well be that a 'piece by piece' approach did in the end lead to greater understanding, as teachers were able to reflect on small pieces of practice as they went along. It might also be the case that the majority of the teachers at Greenside, at the end of two years' development, would begin to be receptive to more 'in-depth' development of 'Using and Applying Mathematics', having achieved some degree of familiarity with the attainment target, and having some classroom experience to reflect on.

Chapter 9. Nature and nurture - three singularities

> Teachers can and do want to change, but the possibilities for change are shaped by their horizons of understanding and by the tradition of teaching within which they work. (Louden, 1991, p. xii)

9.1 Introduction

The introduction in 1989 of the National Curriculum in England and Wales was an imposed change of considerable magnitude and complexity. The focus of this work has been on just one part of one of the subject curricula, Attainment Target 1 in the mathematics curriculum, using the implementation of the process-based aspects of mathematics identified in this target as a critical case for examining the change process in a primary school. The context for the research was described in Chapter 1. Three singularities, crucial to understanding change in this area have emerged through data analysis: the first of these relates to the innovation of 'Using and Applying Mathematics' itself; the second to the teachers charged with its implementation, and the third to the role of the school in making provision for individual and collective needs.

The singular nature of Ma1, 'Using and Applying Mathematics'
A difference in kind
UAM and 'school mathematics'
Potential sources of support for teachers
UAM at Greenside School
The singular nature of individual teachers
Responses to the characteristics of the innovation itself
Need, clarity, complexity, quality/practicality, feel
Responses to the school's mathematics development programme
Personal factors, position in the school
The singular nurturing role required from the school
Recognition of individual differences
Identification of difficulties associated with the innovation
Clarification of ideas of 'merit' and 'worth
Provision of appropriate individual and collective learning opportunities
Provision for reflection and evaluation
Adoption of a flexible approach to time and development

Table 9.1 The three singularities and their component parts

Table 9.1 presents these three singularities, outlining their component parts which are discussed further in the text. A model for approaching the process of change in beliefs

and practice is then suggested, illustrated through extracts from data collected on one of the participants on the research - Liz, the Junior co-ordinator at Greenside School.

9.2 The singular nature of Ma1, 'Using and Applying Mathematics'

Some technological models of change have regarded the innovation itself in unproblematic terms (see Chapter 2). Experience from this research would indicate that the innovation of 'Using and Applying Mathematics' cannot be regarded in this way: this innovation is problematic for a variety of reasons which will now be explored.

9.2.1 A difference in kind

With the introduction of the National Curriculum, increased content in many subject areas was perceived as a source of anxiety for teachers in terms of adequate knowledge of the subjects rather than in how they were taught. There were certainly shifts in emphasis, for example between the importance of different aspects of the English curriculum, but these shifts did not necessarily imply accompanying shifts in pedagogy, except perhaps in very extreme cases.

The focus on process skills, found in both the science and mathematics Attainment Target 1, did seem to be of a different nature, perhaps requiring similar responses. In the case of science, however, it may well have been the case that, prior to the introduction of the National Curriculum, process skills were an accepted part of primary science. In my own experience, it had been the received wisdom from advisers and academics for several years prior to 1989 that the skills of observation, the formulation and testing of hypotheses, the drawing of conclusions, took precedence over, or at least received equal attention to, specific areas of subject content. This view is illustrated by one of the teachers described by Woods & Jeffrey (1996) who felt that what was needed was fewer subject topics, studied in greater depth, with the process skills as a focus.

> *The in-depth exploration, the scientific method, that's what you are after in young children. It doesn't actually matter whether you do it through looking at tadpoles, or making electrical circuits really, you are developing that enquiring mind, that enquiring spirit.* (Woods & Jeffrey, 1996, p. 131)

The Science Evaluation Project (Russell, Qualter & McGuigan, 1993) commented on the existence of teachers,

> particularly in primary schools, for whom the *practical* nature of science corresponds closely to their ideas about how pupils learn via direct experiences.

> For them, the Order contains far too much science subject 'content' and, certainly, those aspects of the Order that are not amenable to direct practical experience are likely to be neglected. This view is consistent with a notion of progression in terms of the development of science process skills, and differentiation is understood as being achieved when, faced with the same open-ended problem, different pupils approach it in different ways ... . (p. 28)

This was not the case with mathematics. The importance of the process skills, increasingly creeping into HMI and DES publications since the late '70s, was recognised by a small group of committed teachers and was being advocated by advisers and maths consultants, but had not permeated through to the ordinary primary teacher in the classroom to any great extent. Mathematics was not thought of in terms of process skills as a vehicle for the learning of content.

9.2.2 UAM and 'school mathematics'

Primary teachers are generalists, with responsibilities for teaching all the subjects in the primary curriculum, even though they will have specialised in one subject either at degree level or as part of their BEd. As has been mentioned already in Chapter 6, few are mathematics specialists, most are qualified in mathematics up to 'O' Level or GCSE (Askew et al, 1993), and some, who are in the later stages of their careers, entered the profession when this minimal qualification in mathematics was not required.

It is likely that teachers share the feelings of many others in the adult population about mathematics - not only in terms of deeply rooted anxieties about their ability to learn and perform mathematics (Buxton, 1981), but also about the nature of what the majority would describe as 'mathematics'. Coben (1996), describing research into adults learning mathematics, termed 'invisible mathematics' the mathematics which people could and did do in their everyday lives, but which they did not recognise as 'mathematics'.

> 'Proper mathematics', for most of our interviewees, seems to consist mainly of arithmetic - indeed not only arithmetic, but standard algorithms in arithmetic. This is compounded by the widely-held view amongst our subjects that there is only one standard algorithm for each operation - usually the one they were taught in school. (p. 8)

Although a restricted focus on arithmetic may not be common to all views of what constitutes 'proper mathematics', other characteristics are. Gregg (1995), described the existence of a school mathematics tradition at high school level whose characteristics included an emphasis on the presentation of mathematics as a collection of facts and procedures which the student followed to obtain the correct answers; mathematical authority emanating from the teacher and the textbook, and information being

transferred from teacher to student through classroom interaction. The reform movement as exemplified in the NCTM Standards in the USA (a reform with a similar focus to that of 'Using and Applying Mathematics') could, according to Gregg, be seen as "in contrast to the beliefs and practices of the school mathematics tradition" (p. 443). Nolder (1992b), also reporting on work in secondary schools, pointed to the phenomenon of 'residual ideologies' (p. 166), which included teachers' view of their role as transmitters of knowledge, a view that was being challenged by the introduction of teacher-assessed practical and investigative work.

Civil (1993), working with pre-service elementary school teachers, noted "the most prominent idea that all the students shared was that their role as teachers was to tell the children what to do. This was what most of them had experienced in their schooling and was consistent with their expectations even then as students" (p. 84). Peterson (1989) described elementary mathematics classrooms as "teacher-directed whole-group instruction on predominantly low-level mathematics content followed by teacher monitoring of individual student seatwork that emphasizes mathematical knowledge and skills" (pp. 3-5). In addition, the traditional mathematics curriculum had been "based on the assumption that computational skills must be learned before children are taught to solve even simple word problems" (p. 7), an assumption also noted by Hembree & Marsh (1993).

The practice of classroom mathematics in the primary school has been characterised by considerable reliance on commercial mathematics materials, both historically and, since 1989, as mediators of the mathematics National Curriculum. The Mathematics Evaluation Project gave figures of 33% of Key Stage 1 and 59% of Key Stage 2 teachers reporting that 50% or more of the work of their classes came from a published scheme (Askew et al., 1993). These materials did not, in the main, permit the implementation of Ma1 in a manner appropriate to the attainment target, if used extensively and without teacher intervention.

The dilemma for teachers of resolving conflicting views of mathematics teaching was illustrated by Wood, Cobb & Yackel (1991). "The final conflict to be resolved occurred in the latter half of the year and involved the tension between encouraging children's individual constructions and establishing the taken-as-shared mathematical meanings held by the wider society" (p. 609). This dilemma is at present being exacerbated by mixed messages about the teaching of mathematics emanating from the Office for Standards in Education. While recent publications are still calling for more opportunities to be provided for children to use and apply their mathematical skills effectively (OFSTED, 1996b), the Chief Inspector for Schools is calling for an increase

in whole-class teaching for mathematics. A transmission model of teaching seems to be reflected in this call, and may well re-affirm long-established ideas of how mathematics should be taught in schools.

9.2.3 Potential sources of support for teachers

If 'Using and Applying Mathematics', with its focus on applications, problem solving and investigations, is to be considered as an integral part of the mathematics curriculum, as the National Curriculum intends, then ideas that conflict with traditional views of what constitutes 'school mathematics' must be accommodated.

Most of the teachers interviewed for the Mathematics Evaluation Project (see Chapter 1), and teachers interviewed in the context of this research were aware, in a rather uncertain way, that 'Using and Applying Mathematics' had implications for teaching style and classroom practice, but could not clearly define what these implications might be. Teachers' views of "what constitutes a problem in mathematics, their views about the nature of mathematics in general and of problem solving in particular, their attitudes towards problem solving, and their beliefs about what it means to do mathematics" had, according to Thompson (1989, p 234), been the main difficulties she encountered in helping teachers learn how to teach problem solving.

In 1982, Lester was writing that "neither mathematics education nor cognitive psychology has yet come up with a reasonable theory of problem-solving instruction, let alone any prescriptions for instruction which have broad application to mathematics classrooms" (Lester, 1982, p. 58) . Desforges & Cockburn (1987), writing several years later, but before the introduction of the National Curriculum, commented on the current enthusiasm by researchers for the introduction of problem solving and investigational work into primary mathematics, and pointed to a variety of problems lying in wait for teachers attempting to embrace these ideas, not the least of these being a lack of evidence from "normal classrooms working under normal conditions" (p. 147) as to how problem solving skills could be taught. In terms of the application of mathematics to the solving of problems, while the teachers they studied

> fully supported the notion of applications work and went some little way towards realizing it, they felt that for children of this age the ideas had never been properly thought through in terms of identifying the sort of skills that were expected or in designing the kinds of task and specifying the resources needed to foster these capacities. (p. 133)

Desforges & Cockburn felt that "mathematics education experts have failed to identify [...] adequate conceptions of the structure of mathematics problem solving as it

develops in this age range" (p. 154). Silver (1985) complained about the 'atheoretical nature' (p. 249) of the research on the teaching of problem solving and felt that teachers were faced with "a popular pedagogical literature replete with suggestions for the teaching of problem solving [...] and virtually no research base on which to support or refute the suggestions" (p. 249). It is interesting to consider what has been written that might help teachers solve the dilemma of implementing 'Using and Applying Mathematics', now a mandatory part of the mathematics curriculum.

Problem solving as context, as skill and as an art were themes considered by Stanic & Kilpatrick (1989) in a historical perspective on problem solving. The solving of problems as means to achieve other valuable ends (problem solving as context) had become influential on the mathematics curriculum, they felt, largely as problem solving as practice. A consequence of viewing problem solving as skill had resulted in the restriction of non-routine problem solving to the higher attainers. The "deeper, more comprehensive view of problem solving in the school mathematics curriculum - a view of problem solving as *art* - emerged from the work of George Polya" (p. 15). In this view, the teacher was the key, providing appropriate problems and guidance, and problem solving was for everybody. Although Stanic & Kilpatrick regarded this view of problem solving as the most defensible, they felt that:

> at the same time it is the most problematic theme because it is the most difficult to oprationalize in textbooks and classrooms. The problem for mathematics educators who believe that problem solving is an art form is how to develop this artistic ability in students" (p. 17).

In contrast, Lave, Smith & Butler (1989) suggested an apprenticeship model for problem solving, based on an assumption that all practice was situated, and emphasising the "learning of practice, in practice" (p. 79) - an approach with major implications for the organisation of classrooms, curricula and assessment. This model challenged the conventional view of a distinction in both situation and time between the learning experience and the application of the learned knowledge.

Attempts have been made to provide teachers with support resources directly related to Ma1. More accessible than the literature described above, though not widely consulted by classroom teachers (Askew et al, 1993), was the non-statutory guidance (DES/WO, 1989b) produced to accompany the mathematics National Curriculum. Although describing 'Using and Applying Mathematics' as "perhaps the single most significant challenge for the teaching of mathematics required by the National Curriculum" (p. D5), direct classroom implications of this challenge were not really spelled out. Other guidance materials (NCC, 1991b; NCC, 1992) were more explicit in exemplifying

appropriate changes in teaching style and classroom practice, but were not readily available in all schools. Even if they had been, many teachers would still have needed help in interpreting them; the length of the initial stride from the 'school mathematics' starting point of most primary teachers was too great a distance for most teachers to cover on their own.

9.2.4 UAM at Greenside School

It had appeared to me, and been noted during the research, that the mathematics development of Ma1 was causing greater difficulties to teachers at Greenside School, than developments in other areas of the curriculum which were also part of the School Development Plan. In maintaining contact with the school through informal visits to the see the mathematics co-ordinator and the Headteacher after the completion of the fieldwork, I was able to raise questions about the greater difficulty of development in mathematics, than in other subject areas. The Headteacher indicated that she felt there was a greater preponderance of shared beliefs about other areas, especially, for example, reading and English. She felt that not only did mathematics not have these shared beliefs about Ma1, but also that the level of understanding about what was needed was lower in that area.

She mentioned pressure from parents as instrumental in keeping reading in the forefront of teachers' minds, but felt that this pressure never extended to maths - parents did not come in to school to discuss progress in maths to anything like the same extent.

Teachers who are not mathematics specialists generally derive their ideas of what constitutes school mathematics from their own school experiences. Views similar to those found by Civil (1993, p. 84) regarding a teacher's role as "tell[ing] children what to do" were evident in the approach of some teachers at Greenside School (see Notes on Inset Meeting, June '94).

There were examples of teachers (described in Chapter 7) who, at the beginning of the research, were aware that pupils did not realise that they were doing mathematics, even when they were; the teachers did not feel it necessary to make the mathematics in a task explicit. This appeared to be the case when examples of what might be described as 'Using and Applying Mathematics' were being discussed, and the teachers did not appear to regard this as problematic - in fact, rather the opposite. Limited views of mathematics were exemplified by apologetic descriptions of some activities; the use of measuring in, for example, a cooking activity, was described as not being *"maths as*

such". This could result in the perpetuation, for both pupils and teachers, of restricted ideas of what constitutes 'school mathematics' or 'proper mathematics'. Although the commercial mathematics scheme was used circumspectly on the whole at Greenside, 'doing maths' was used by some teachers as a description of the mathematics from commercial scheme materials, thereby perhaps reinforcing ideas of written pages of scheme work as 'proper mathematics' in the eyes of children and parents.

Limited views about mathematics were closely associated with limited views of 'Using and Applying Mathematics' in the case of some teachers. Disturbing evidence from this research relates to the impact of teacher training on new teachers' understanding of 'Using and Applying Mathematics'. With the exception of the two teachers who had taken mathematics as a main subject in their teacher training, the other teachers who had trained at the time of, or since the introduction of, the National Curriculum (with its mandatory Attainment Target(s) of 'Using and Applying Mathematics'), did not mention any specific help from their training to support them in this area.

> Una: *I'm trying to think what we did, we used to do activities in groups, um, it might have been, say they were doing number work, it might have been working out number patterns, that kind of thing, which would have been all well and good after doing, you know, the rest of it first, but it didn't build your confidence up because it wasn't really giving you anything to come away with, any real knowledge, it was just making you perhaps think about it a little bit. I just didn't really think it was very good, it didn't really set you up for anything.*
>
> *[...]*
>
> A: *So, I mean, what do you think they were trying to do in those sessions?*
>
> Una: *I think they were trying to make you stop and think, and basically think that you don't have to teach maths from a book, it doesn't have to be boring, you can do activities where the children work in groups and discuss things, try things out, which, you know, I agree with, and I think that's good, but they didn't teach us the foundation to work from, if you can understand what I'm saying ...*

A combination of circumstances can result in the adaptation of an innovation (Fullan, 1988), thereby mediating initial intentions. First reported in relation to 'Using and Applying Mathematics' in the Mathematics Evaluation Project (Askew et al, 1993), indications at the beginning of this research indicated a similar phenomenon. Restricted views of the 'Using and Applying Mathematics', more easily accommodated into existing belief systems about mathematics and its teaching (eg. as practical, or as investigations, described in Chapter 7) were evident. In several cases, during the time of the research, teachers had extended their views of the target, and made corresponding

changes in belief systems. Established from conversations in interviews, it remained to be seen whether these changes would be exemplified in classroom practice.

9.3 The singular nature of individual teachers

Some recent research has been able to identify shared responses from teachers to aspects of the innovations initiated through the Education Reform Act (Great Britain (Education Reform Act) 1988) (eg. Clarke & Christie, 1996, Mentor et al., 1996 (in press)). I have not been able to make general statements about the responses of the teachers at Greenside School, as a group, to the development of the innovation of Ma1. Indeed, one of the most striking features to emerge from this case study has been the essential singularity of each teacher's reactions. Any attempt to impose hard and fast groupings or categorisations would have misrepresented the data. Intentions may have been shared, or ostensibly shared, but responses, it seemed, remained largely individual. Although these teachers all participated in a mathematics development programme, their perceptions of its meaning and relevance to them varied from teacher to teacher.

9.3.1 Responses to the characteristics of the innovation itself

Fullan (1991) defined four characteristics of a proposed change as being of importance in its implementation - need, clarity, complexity and quality or practicality. For some teachers, all these four were problematic, with an additional affective characteristic also being identified. For other teachers, some characteristics of the innovation were problematic, but not others.

9.3.1.1 Need

The call for a change in the mathematics curriculum to include a requirement for teachers to incorporate process skills in their mathematics teaching could not, in 1989, be said to stem from the primary classroom teacher. The mathematics education community had been recommending such a change for several years (see Chapter 1) and a small number of teachers, particularly at secondary level were also committed to reform, but a groundswell of dissatisfaction with the mathematics curriculum was not emerging from the primary arena.

The mandatory nature of the attainment target then complicated the issue for most primary teachers. The need became one of 'delivery' of the curriculum stemming from a deficit feeling of not yet implementing the whole mathematics curriculum, rather than from a positive feeling of desire for change.

The decision to promote development in the area of 'practical/investigational maths' at Greenside School was taken before I started work in the school, but initial discussion with the Headteacher and the mathematics post-holder indicated a combination of these two feelings in the school, with a minority (which included both Head and post-holder) expressing this feeling of a desire for change. Using Askew's adaptations of the terms 'merit' and 'worth' (see Chapter 5, Section 5.4.1), the Headteacher, Ruth (MC, KI) and Mary (CC, KI) appeared to be convinced of the merit of the innovation at the outset of the research - in other words they felt that it had intrinsic value in itself. The two teachers who joined the staff half way through the research (Olivia and Nell) came to the school committed to its merit. Other teachers appeared to be partially convinced: Eric (DH, KI), Meg (WG1), Mike, Madeleine (KI) and Liz (JC) all referred positively to some aspects of the target in terms of benefits for pupils. It was my opinion that, at the beginning of the research, the other teachers were unconvinced of Ma1's intrinsic merit, but were aware that 'delivery' of the mathematics curriculum included work of this type. By the end of the research, considerably more teachers referred positively to the target and appeared to be changing their ideas of the merit of Ma1. The teachers knew that they did not all feel the same, but were on the whole not prepared to make judgements about colleagues' beliefs or practice (see Chapter 8).

Less was apparently known about the worth of the innovation to, for example, parents. There seemed to be an assumption that parents attributed worth to pages of sums set out neatly in a book. There had not been any formal attempt to assess parents' reactions, but towards the end of the two years of fieldwork, teachers were putting out feelers towards ascertaining parents' responses. In Year 6, Mary (CC, KI) and Carolyn were setting investigative activities for homework, and noting responses from parents (*"some loved it and some hated it"* (Carolyn, Obs. 21, February '95)). Una started this later in the year (Una, Int. 29, June '95). Madeleine, in her final interview, described how she was prepared to explain to parents now why there was less on paper, *"less counting and sums"* (Int. 37, July '95).

9.3.1.2 Clarity

Attention has been drawn to the need for clarity in an innovation if it is to succeed (eg. Gross, Giaquinta & Bernstein, 1971, Fullan, 1991). Evidence from the Mathematics Evaluation project (dating from 1991/2) has already been cited in Chapter 1 supporting the lack of clarity surrounding this attainment target, not only from the point of view of primary teachers' varied interpretations of what was expected of them, but also from a consideration of how helpful the document was in introducing teachers to ideas which were likely to be new to them.

In 1993, Ruth, the mathematics co-ordinator at Greenside, was revealing her own inadequacies in presenting a comprehensible version of Ma1 to her staff as an integral part of the mathematics progression which she was preparing (see Chapter 6; 6.3.3.1). Ruth had qualifications in mathematics as the main subject in her BEd, as well as at A level, and had played a long-standing role as maths co-ordinator, but was still unsure herself of the implications of some of the statements of attainment, particularly in relation to the examples given in the document. Another teacher expressed a similar opinion:

> Tessa: *Yes, really. I don't actually think they've given us enough help on it. I mean they've provided that attainment target one, they've written all those lovely statements down, they actually haven't given us any practical ideas on how to carry it out.* (Tessa, IC, Int. 14, January '94)

Another cause of confusion had been the messages which seemed to have emerged over recent years from the school's LEA about the value of, and need for, 'investigations' in the primary classroom. These, in a situation of uncertainty and insecurity, appeared to have been grasped and focused on to the exclusion of other implications of the target (see also Chapter 7, Section 7.2.2.4).

> Ruth: *What they were saying is AT1, but they're calling it 'practical and investigational' I think, partly because the borough got on to the bandwagon of investigational maths a few years back, flogged it to death, everyone thinks that's the way to do practical work in the classroom, do an investigation, I think, so that's why I wanted to change it after that meeting.* (Ruth, MC, KI, Int. 9, January '94)

Teachers also appeared initially to have focused on those aspects of the target which were clearer to them and could be more readily understood (eg the need to apply mathematical understanding in other subject areas, the need to recognise and encourage pupils' individual methods and ways of working) and worked on these to the exclusion of other aspects of the target (particularly those relating to reasoning, logic and proof), (see Chapter 7, Section 7.2.2.4). As the development progressed, the clarity of more aspects of the target were becoming apparent - a broader coverage of the three strands was developing (see Chapter 8).

9.3.1.3 Complexity

Complexity refers to the difficulty and extent of the change required of the individuals responsible for its implementation. As described in Section 9.2.2, the requirements of Ma1 were not within many of the teachers' understanding of what teaching maths entailed.

Teachers at Greenside school expressed a variety of beliefs about mathematics and its teaching (see Chapter 7), and used a commercial scheme in varying degrees, but many relied on the scheme to provide a certain core of content for the mathematics in the classrooms, although not claiming that it addressed Ma1.

> Liz: *I mean, Peak have supposedly got investigations in there, but I don't think you can really count those because they tell you what you've got to do...* (Liz, JC, Int. 4, November '93)

An initial view, common to several teachers at the school, of Ma1 as something separate to the scheme work which could be undertaken in weekly 'investigation' sessions taught by the Deputy Head, may have resulted from a way of working which used the scheme as a core in the planning process.

When teachers addressed the complexity of a change in teaching style required for Ma1, they identified such constraints as inexperience and lack of confidence.

> Diana: *I think it depends how confident you feel with the children, because you've got to let go a little, you've got to feel you can rein them back, so, you know, perhaps, those of us who have been teaching a bit probably feel quite happy about it, more difficult for somebody relatively inexperienced.* (Diana, Int. 11)

> Eric: *Because I think really what it is is that an investigation is a fairly ... where you actually relax the control and the children take the control, if you're going to do it with purely open-ended, and some people I think find that difficult, and sort of are insecure with that.* (Eric, Int. 16)

In some cases, the realisation was just beginning that changes in teaching style were required for the implementation of Ma1.

9.3.1.4 Quality/Practicality

Making judgements about the quality or practicality of an innovation requires some experience upon which to base these judgements. There are also implications in terms of the availability of materials. In the two years of the mathematics development at

Greenside observed by the researcher, some teachers had few examples of classroom experiences of their own (as opposed to those conducted by the adviser) upon which to evaluate their practice in terms either of their own behaviours or those of their pupils. It is perhaps significant that as soon as they were required to undertake certain activities, discussion of quality/practicality increased.

Several teachers also felt that decisions about the practicality of this innovation had to be made within the context of the full set of demands made by the introduction of the National Curriculum and could not be seen in isolation from these.

> Diana: *No, well it's making sure what they're doing is valid, and they're not just going off at a tangent which is not where you want them to go, and might be perfectly valid educational tangent, but in this day and age you can't, you've got to be justifying what you're doing, particularly as you've got a pretty tight plan for the week, if you deviate from that you've got to justify why haven't done it in the next week* ... . (Diana, Int. 11, January '94)

These competing demands were not voiced so urgently in the final interviews.

9.3.1.5 The 'Feel' of Ma1

In addition to these four characteristics suggested by Fullan (1991), all of which, I have suggested, were problematic for some teachers, a further characteristic has emerged from the work at Greenside school - an affective characteristic - the 'feel' of Ma1.

As described in Chapter 8 (8.3.3.1), words used to describe Ma1 in the first interviews conducted at the beginning of the research gave some indication of the unease and even fear which questions about 'Using and Applying Mathematics' engendered. It was a *"real bug-bear"* or *"ghastly"*. Changes in this 'feel' were noted over the course of the two years. The feeling of intimidation, noted at the beginning of the research, had diminished. However, the presence of these feelings during the time of the school's mathematics development clearly affected teachers' willingness or ability to engage with the development process. It may have been the case that engaging in compulsory activities as required by the topic framework was the only way, for some teachers, to provoke a step into the unknown.

9.3.2 Responses to the school's mathematics development programme

A distinction between this section and the previous one is somewhat specious in that there is a wide degree of overlap between responses to Ma1 itself, and responses to the school's attempt to develop Ma1. Clearly the latter depended to a considerable extent on the former, and therefore teachers responses to many of the characteristics described in the previous section also affected their engagement with the change process.

Apart from responses specific to Ma1, there were other factors - many of these related to the teachers as a person - which contributed to the way in which they responded to the school's attempts to develop this area of mathematics. As described in the mapping analysis in Chapter 8 (8.2.2), it was possible to see some pattern in the diversity of responses, but caution was exercised in making too many assumptions about teachers sharing characteristics and working in similar ways.

9.3.2.1 Personal factors

Teachers varied in the degree to which personal factors impinged upon the focus that they were able to bring to the mathematics development. Some were able to bring strong subject knowledge of mathematics and an accompanying confidence to their classrooms; some suffered from feelings of failure in their own mathematics. Some were confident practitioners generally, and therefore perhaps felt more able to take risks; some were new to teaching and still feeling their way; some were disillusioned and unwilling to take on new ideas. Some appeared to be reflective by nature; others needed pressure to reflect upon their classroom practice.

Individual critical incidents affected teachers at different times and with different intensities. Similarly outside events appeared to affect some teachers more than others. Conditions in their lives outside school affected how much time and energy they had to put in to this development.

9.3.2.2 Position in the school

Positions of responsibility in the school had implications for the behaviour of those holding them. There were expectations of involvement in development: Mary (CC, KI) felt these expectations keenly as curriculum and assessment co-ordinator, and both she and Tessa, the Infant co-ordinator, expressed enjoyment in carrying out a demanding role. In Ruth's case (MC, KI), however, enjoyment was tempered so much by the feeling that resources did not meet needs in the way in which she was able to carry out her role as mathematics co-ordinator, that strains and tension overcame enjoyment.

9.4 The singular nurturing role required from the school

As has been emphasised in this research, Greenside School possessed enormous strengths. Here was a group of committed, professional teachers, led by a strong but flexible and sensitive Headteacher who, together, were developing a collaborative culture in response to the many demands being made upon them at this time of educational change. Yet, in the case of their mathematics development, more appeared to be needed, even though the perception of most teachers was that progress had been made, both individually, and as a school.

The nature of the difficulties relating specifically to the implementation of Ma1, and the individual nature of responses of teachers to change, brought into focus the singular nature of the nurturing role which a school must adopt if it is to respond to this complexity and cater for these differences and difficulties. Working with Greenside School and documenting the development of their mathematics has led to an identification of six aspects of what I have termed a 'nurturing' role which seem to be of particular importance in facilitating teacher development.

9.4.1 Recognition of individual differences

Throughout this thesis, individual differences have emerged through the analysis as being of critical importance in affecting responses to change. These differences have implications for the strategies to be employed in initiating change, and therefore need to be recognised by those responsible for the development. The same strategies will be relevant to some teachers, but not to others. As the Greenside development exemplified, some teachers were able to take and use ideas from the LEA adviser, but these Inset activities did not prove fruitful for others. Teachers responded differently to the pressure of compulsory activities, either feeling that they would not have got started without them, or, alternatively, feeling that they were self-starters and did not need them.

It is important for the school to be able to identify these individual differences through evaluation and monitoring of the progress of development, thus in turn identifying a variety of strategies which might be appropriate to satisfy the needs of different individuals.

9.4.2 Identification of difficulties associated with the innovation

At Greenside School, difficulties associated with 'Using and Applying Mathematics were generalised, rather than being made specific. Approaching Ma1 in smaller, targeted parts from the outset and working with teachers on those in depth, might have resulted in greater accessibility. It was noticeable that some teachers did this for themselves, focusing particularly on one or two aspects and trying to develop those.

9.4.3 Clarification of ideas of 'merit' and 'worth'

Closely associated with the identification of difficulties is the establishment of where teachers would place themselves regarding the intrinsic value of Ma1. I would suggest that it would have helped Ruth (MC, KI), and later Nell (MC) if they had been able to establish at an early stage the motives of different teachers in giving Ma1 priority for development. Some attempt to establish ideas of the 'worth' of UAM in the eyes of parents might have provoked discussion and revealed whether teachers were working from motives of 'delivery', or from ideas of intrinsic merit.

9.4.4 Provision of appropriate individual and collective learning experiences

An approach which strikes a balance between recognising and appreciating the individualism of each teacher and providing a collegial culture to support and develop individual responses is that suggested by Fullan & Hargreaves (1992). Greenside school strove very hard to encourage just such a collegial culture. Its structure of working groups of differing sizes and with differing objectives provided (as discussed in Chapter 5) opportunities for teachers to contribute with confidence in the knowledge that their contributions were valued. The recognition of the importance of, and the support for, the role of the subject co-ordinator (although not necessarily regarded as sufficient (see Chapter 6)) made use of the strengths which individual members of staff possessed and encouraged continuity in development through changes in personnel.

It has not been possible within the constraints of this work, to address in any depth the literature on Inservice training in addition to the other areas of literature studied. However, in relation to this study it would seem that an emphasis on the importance of a client-centred model for Inservice education (Day, 1981) is appropriate if individual differences have been recognised and identified. Among the assumptions made by this model is that the motivation for learning must arise out of a problem which has been identified by the client. As discussed above, it may be that the motives for identifying the problem **as a problem** are also important.

Other conditions for the effectiveness of Inset (Advisory Committee on the Supply and Education of Teachers, 1988) include the identification by teachers of their own training needs, and the precise targeting of provision. Greenside had made strenuous efforts to provide varied forms of support for the teachers, and included amongst these was the in-class support from the adviser that the teachers had themselves identified as necessary.

Collective learning opportunities were provided through the working, departmental and whole staff groups, but teachers found it difficult to address issues of beliefs and feelings through these collective activities and they did not on the whole provide the stimulus for reflection or evaluation that was needed. The levelling meetings referred to in Chapter 4 and Chapter 8 were the exception to this: based on experience of practice they seemed to be the beginning of greater depth in approaching the complexity of Ma1.

9.4.5 Provision for reflection and evaluation

The pressured nature of teachers' time was documented several times in fieldnotes. The teachers at Greenside worked extremely hard, and I frequently felt that I was imposing on the few spare minutes they had in between meetings and preparation. I noted on the occasion of one set of Inset activities conducted by the adviser (Fieldnotes 37, June '94), that some teachers had had no time to pause for thought during the whole day, because of competing demands of meetings. How difficult then to engage in 'reflection-on-action' (Schon, 1987), to consider "who benefits from current practices, how these practices might be changed ..." (Louden, 1991, p. 160). Limited responses to the classroom observations returned to the teachers for comment were attributable, I felt, to this lack of thinking time. Without this time for reflection, either in the classroom, or outside it, the process of change is likely to stagnate.

A school's ability to make provision for more time for reflection cannot be lightly commented on in the present context of educational change. The Headteacher was certainly aware of the demands she and the staff faced, and took steps to remedy the situation (see Chapter 5) when she felt she could.

Those involved in management at senior level at Greenside School appreciated the need for the evaluation of development, but circumstances sometimes militated against being able to carry this through in practice. The decision to continue the development of Ma1 through into a second year was not the result of a considered evaluation of the previous years' development, although individuals might have made their own evaluation as part

of their subsequent decision-making. Such an evaluation might, again, have provided an opportunity for addressing the deeper issues of beliefs, with discussion functioning at the level of 'extended' rather than 'bounded' collaboration (Fullan & Hargreaves, 1992b, pp. 74/5)

9.4.6 Adoption of a flexible approach to time and development

I made the comment at the end of Chapter 8, that the teachers at Greenside might, at the end of two years of development, when Ma1 had officially ceased to be a priority on the School Development Plan, be ready for more positive engagement with the change process. The Headteacher acknowledged that the development should not be regarded as 'over' by her choice of mathematics as the first area of the curriculum to receive priority under the new monitoring provision for co-ordinators. This ability to see some development as completed and some as needing further attention, (and making the necessary provision), signalled a willingness to be flexible and encouraged the mathematics development.

This flexibility appeared even more important in the light of the radical staff changes that the school had experienced over the two years of fieldwork. Of the 18 staff (including the Headteacher) who were initially involved in the research, only 12 remained at the end of 1995. Shortly after the completion of the fieldwork, Eric (DH, KI) was promoted to a Headship in a neighbouring school. Four teachers who arrived new to the school were involved in the research at a later stage, one teacher (Ruth, MC, KI) was away for nine months on maternity leave, and several new teachers came who were not involved in the research. With staff change of this magnitude, determination, vision and flexibility are needed to maintain development in any area, let alone one which is proving extremely difficult for all concerned.

9.5 The process of change

The complexity of Ma1 itself was becoming more accessible to individual teachers over the course of the two years of development, but it was a slow process. Some teachers had made great strides in their own understanding and were beginning to feel more confident about classroom practice; some teachers had engaged very little with it. The reasons for this, it is suggested, came not from any lack of enthusiasm, hard work or good intentions on the part of the school, but rather because it had not proved possible to provide an entry point into the change process for each individual teacher. The essentially iterative and reflective nature of the relationship between changing beliefs

and changing practice requires teachers to experience situations in which beliefs are practised and reflected upon in both in the classroom situation and outside it.

Hoyles (1992) regards a distinction between 'beliefs' and 'beliefs-in-practice' as problematic. In terms of the mathematics experienced by pupils in the classroom I would agree with this. However, I would suggest that teachers, through reflection, may come to understand that the two can be distinguished, and that recognition of a distinction between the two may lead to engagement with the change process. An ongoing provision of stimuli and opportunities for reflection may be what is needed to facilitate the change process.

Figure 9.1 illustrates the movement of one teacher (Liz, JC) through the process of changing one belief which she expressed in her first interview.

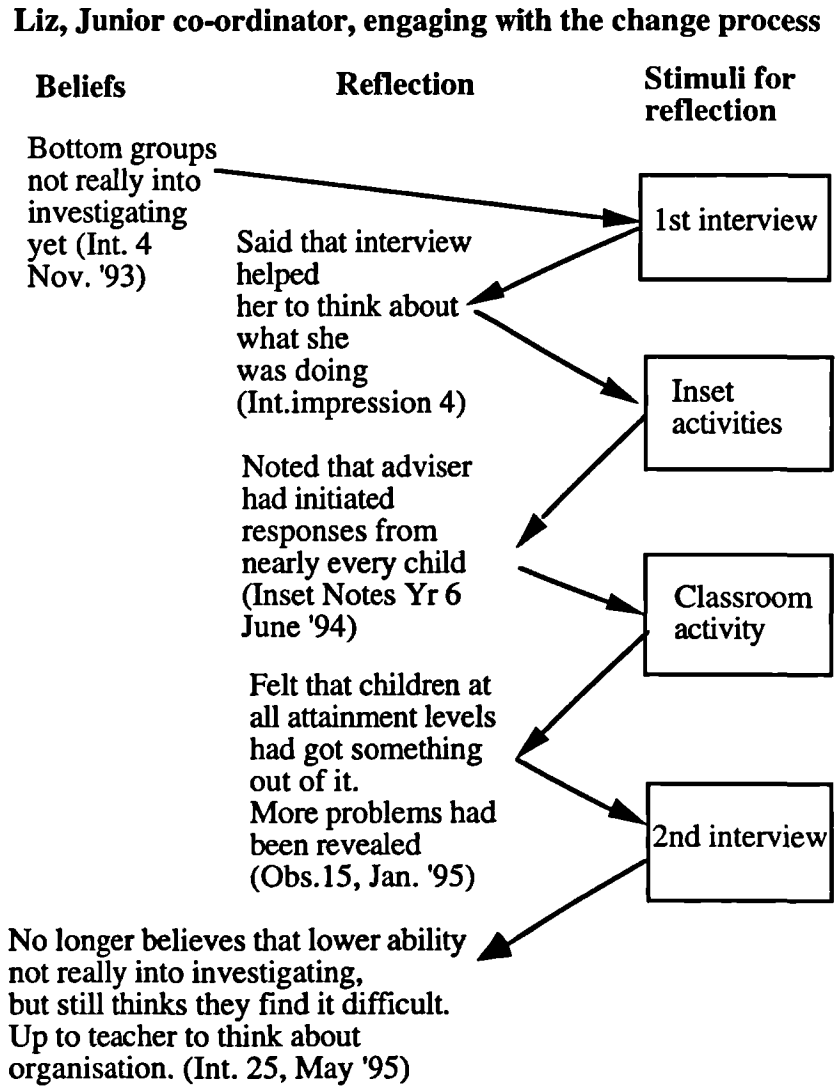

Figure 9.1 Engagement of one teacher with the change process

Some of the stimuli for reflection in this case were my activities as researcher. Liz's initial belief was that investigational work was not yet appropriate for her lower attainers in Year 6:

> *Oh yes, I think they're getting a good sort of mix of practical maths, investigational maths, revision of the number skills, the top groups are anyway, the bottom groups are more plod, plodding away to get some concepts, and sort of using practical maths to do that, but they're not really into investigating yet.* (Liz, JC, Int. 4, November '93)

This belief was traced through other reflections and comments noted in the data.

In this model, the starting point for any individual teacher to engage with the change process will be a stimulus to reflection. This stimulus may consist of something provided by the school, or some self-initiated activity on the part of the teacher. Any movement from the starting point will depend upon that teacher engaging in reflection either upon how the change in her beliefs might be reflected in her practice, or upon how the change in practice (perhaps even through an activity which she did not engage in voluntarily) might make her reconsider her beliefs. Reflection acts as a catalyst for movement. Different teachers will engage with the process in different ways. Some may remain unaffected by either changes in belief or practice. Some, engaging initially reluctantly in a change in practice, may quickly make some accommodation to their belief structure and move on to further changes in practice.

The ability of the school to provide both the pressure to engage in, and the support to reflect upon a variety of activities which might act as starting points for individual teachers is crucial to the process.

At Greenside school, the mapping analysis indicated that visits and demonstrations by the mathematics adviser stimulated reflection in some teachers. For others, these sessions appeared to have had no lasting results, but they themselves had been provoked into reflection by compulsory investigative activities which were to be used to compare assessment between different year groups. The provision by the departmental levelling meetings of focused discussion on these activities had clarified objectives and ways of working in some teachers' minds and encouraged repetition of similar activities which could be said to require changes in these teachers' practice. Some teachers reflected through professional talk, some were more isolated and not able to take advantage of these opportunities. Other teachers again had initiated their own 'private' Inset activities by reading to increase their knowledge.

Eric: *And honestly I was in the same position, I didn't really know, but when you start having to do it, you read round the topic...* (Eric, DH, KI, Int. 16, January '94)

Mary feels that what has helped her most has been her own hard work concentrating on her planning, becoming very familiar with the documents, reading up and thinking about it, and looking for different ways of employing different investigations in the classroom. (Mary, CC, KI, Int. 26, March '95)

For the maths co-ordinator (Ruth, MC, KI), the opportunity to engage in classroom support work for a limited period had stimulated reflection on her own work and resulted in an identifiable change in her own practice rather than in the teachers she visited. For other teachers the feedback from the researcher's observations had provoked thought about practice.

Provision of variety of stimuli for reflection is not sufficient. Careful thought must also be given to the nature of the most appropriate opportunities for reflection. These might consist of group or whole-school focused discussions, led either internally or externally, depending on the composition and confidence of the staff. They might, more appropriately for some teachers, consist of individual observations and subsequent discussion with one or two colleagues. The choice of ways in which these opportunities are provided is part of the complex 'nurturing' role of the school.

9.6 Conclusion

This chapter has synthesised the elements of particular interest that have arisen during the course of data analysis into three main themes, called singularities here to emphasise their uniqueness.

Using and Applying Mathematics' has characteristics which make it an innovation of particular difficulty for primary teachers. Collaborative development work may not succeed in addressing its complexity in any depth. Such work may need to utilise strategies addressed specifically to the needs of a particular subject - that is, regarded as subject specific, rather than as generally applicable across the whole primary curriculum.

Individual teachers approach innovation in singularly different ways: they bring to any development a personal set of knowledge, beliefs, values, characteristics, and

experiences which inevitably define the motivation they have to engage with the change process and to pursue it once begun.

These first two singularities necessitate the third. Specific to each school, the role of nurturing development and ensuring its continuation must take into account a set of individuals who have different needs and qualities, within its own individual culture and context.

The case study at Greenside School has illuminated the individual nature of change. However, it has also illuminated an iterative, reflective process which can be common to all schools, providing it is interpreted through the eyes of each particular school, and put into practice with the individual needs of each particular school in mind.

During the time of the research, the national context has not remained static. The final chapter, Review, revisits the research questions within the current context of national debate about the teaching of mathematics.

Chapter 10. Review

10.1 Introduction

The decision to undertake research which took account of the broader cultural and contextual factors involved in the responses of teachers to innovation and change was influenced by my own experience of primary teaching and management, and by a study of the literature. The complex interaction of the many factors likely to enhance or inhibit the change process for individuals and for schools, illuminated through this study, justified the making of that decision. In attempting to understand the process of change at Greenside School, the importance of a consideration of teachers' personal circumstances and experiences as well as their beliefs and understanding of mathematics and how it should be taught, has emerged strongly. In turn, teachers' relationships with others, their roles within the school, their participation in group and whole-school activities has pointed to a profile of responses, unique in some ways to each teacher, yet shared in some ways with others. Working within the culture which had been built up in the school, and within the local context of children, parents, the LEA, and the wider national context, these teachers demonstrated individual degrees of engagement with the change process.

The innovation 'Using and Applying Mathematics' has been regarded in this study as a critical case for examining the process of change in a primary school. The difficulties experienced by the teachers at Greenside School in coming to terms with this innovation made it, to some extent, an exceptional case. However, recognition of those same difficulties, likely to be specific to this area of the curriculum, has thrown light on the delicate and individual nature of the change process for individual teachers, a process which is not specific to mathematics.

In this final chapter, the research questions are re-visited in the light of the understandings gained from the research and of the unstable nature of the national context relating to primary mathematics. Within an overall aim of exploring those factors, both school-specific and teacher-specific, that facilitated or inhibited the permeation of 'Using and Applying Mathematics' through a school's mathematics curriculum, this study has given particular attention to the evolution of teachers' beliefs about mathematics, and Mal in particular, and how these beliefs impinged upon practice. It has looked at the individual teacher within the whole-school context, exploring any tensions between individual and collective priorities and whether and how these were addressed. It has considered the strategies employed by the school to

promote the mathematics development, and their impact on the individual teachers within the school.

10.2 Evolution of interpretations of Ma1

Making sense of an innovation is part of the first stage of the change process outlined by Miles (1986), the initiation of change. Making sense of 'Using and Applying Mathematics' has been revealed as a task of major proportions for the primary teachers involved in this study. It is likely that the conflicts and uncertainties surrounding the process aspects of mathematics implied in this attainment target are replicated among the wider population of primary teachers.

The teachers at Greenside School had made their own interpretations of 'Using and Applying Mathematics' - interpretations limited in many of the same ways as those exhibited by teachers interviewed for the Mathematics Evaluation Project (Askew, 1996). In some cases these interpretations had been influenced by messages emanating from the LEA. Interpretations appeared to be derived in part at least from the teachers' own experiences of mathematics, both at school and in their teacher training, which had, in turn, affected their beliefs about the kind of mathematics that it was appropriate to teach in school.

Beliefs in the need to 'tell' pupils things, to 'put over' knowledge, current among some teachers at Greenside School, belong to the model of mathematics described by Gregg (1995) as the school mathematics tradition. Smith (1996) argued that 'teaching by telling' (p. 388) provided teachers with a sense of efficacy that was undermined by the requirements of the current reform movement in the USA (based on the NCTM Standards (NCTM, 1989) and similar in its focus to 'Using and Applying Mathematics') because a "mismatch exists between the pedagogy of current reform and the basis on which mathematics teachers have traditionally felt efficacious in directing student learning" (p. 387).

Although understanding of the implications of Ma1 was still limited at the end of two years of development, there was no doubt that the Greenside teachers had increased their familiarity with the attainment target, and could discuss aspects of it, informed by some experience drawn from classroom activities. This development of ownership was similar to that noted by Prestage (1996) at the end of two years of working with a group of teachers on progression in the mathematics National Curriculum.

> We arrived at the end of the project with our professionalism reasserted and the feeling of a high degree of 'ownership' of the curriculum - maybe now is the time for us to begin to consider the nature of progression in school mathematics. (Prestage, 1996, p. 98)

It is probable that the Greenside teachers will find discussion of Ma1 progressively easier as their classroom experience increases, even though these experiences were still viewed in many cases as a bolt-on additions to the rest of the mathematics curriculum.

10.3 Interplay between interpretations and practice

Teachers' beliefs and views about mathematics in this research were identified from their own descriptions of classroom practice. Belief structures were not necessarily coherent for individual teachers - there were conflicting elements which affected their interpretations of Ma1 and the degree to which it impinged on their practice.

Most of the teachers at Greenside School identified the undertaking of investigative activities, the focusing on pupils' own methods of calculation and recording, as representing changes in their practice. Some had reflected on these and subsequently identified changes in their beliefs about the merit of the innovation of Ma1. Research has identified difficulties involved in changing practice. Whether the changes in beliefs identified by the Greenside teachers would be translated through the mass of contextual, cultural, pedagogical and personal factors into classroom practice remained on the whole to be seen, although it was some teachers' perception that they were doing this already - that they had made progress with implementation. The change process, iterative and reflective in nature, had begun for some teachers.

Institutionalisation of the innovation, however, had yet to be attained - "change is only successful when it has become part of the natural behaviour of teachers in the school. Implementation by itself is not enough" (Hopkins, 1994, p. 79). 'Putting it all together' (see Chapter 8), accepting Ma1 as central to mathematics teaching and exemplifying this in the classroom, was still a characteristic of the few, rather than of the majority of teachers at Greenside School.

10.4 Tensions between individual beliefs and a shared culture

A lack of 'shared' beliefs about the merit of 'Using and Applying Mathematics' was seen to have impeded the mathematics development at Greenside School in that a common foundation for discussion of deeper issues about the innovation did not exist and the

school was not, during the time of the research, able to create it. Louden (1991) considered a gap in understanding as an essential condition for reflection. The larger the gap, he felt, the "more creative the invention needs to be" (p. 191). Perhaps, though, in the case of Ma1, the gap in understanding was too great, at least initially, to be bridged by these teachers. The 'horizon of understanding' (Louden, 1991, p. xii) was too distant.

Although tensions were noted between the views of some individual teachers and the 'group' and 'shared' beliefs described in Chapter 7, these tensions appeared to be less of a constraint on development than the extent of the uncertainty and the unwillingness to address issues in depth - skirting round, rather than focusing in. The actions of the school in focusing on 'Using and Applying Mathematics' as an area for development had revealed tensions relating to the teaching of mathematics which had not perhaps been evident before. However, because of the uncertainties surrounding Ma1, these tensions remained unaddressed. Those teachers with a strong mathematics background at the school may now be in a position to make use of teachers' perceptions of increased confidence to address these tensions. The monitoring role carried out by the mathematics co-ordinator has given her a basis of knowledge about practice upon which to build.

10.5 Whole-school action

The complex role of the school in facilitating engagement with the change process for individual teachers has been described in Chapter 9, with six factors being identified as being of particular importance. Flexible leadership and a collaborative culture provide a framework where individual contributions are valued and an environment sustained in which teachers can work and learn together. Within that supportive system, the innovation can be considered in greater depth, its benefits and drawbacks examined, its potential evaluated. However, the isolation of teachers in the classroom, a cause of concern at Greenside School even though collaborative action was encouraged and supported, requires recognition as a factor which may inhibit the process of change.

Working from increasingly informed positions, teachers can be provided with stimuli for reflection and with opportunities to share thoughts and problems with colleagues as they put new ideas or activities into practice in the classroom. As this process occurs, and individual teachers move in and out of the change process, there will be changes to the culture of mathematics in the school. Whether these changes become embedded as a new culture in the school will depend on the school's ability to sustain engagement

and development and to evaluate both the change process itself, and its results. "The real agenda is not implementing single innovations, but changing the culture of the school" (Hopkins, Ainscow & West, 1994, p. 20).

Schools may not be able to carry out this nurturing role unaided. As this study has illustrated, advice and exemplification from the LEA adviser were important in guiding some of the stimuli for reflection employed by the school, and for personally inspiring some teachers. The quality and financial viability of external support have to be balanced against the use of the skills and knowledge of members of the school community.

External expectations of the extent of on-going development that is feasible in a current circumstances have increased, and schools are also expecting more of themselves. As has already been stressed (Chapter 5), the mathematics development at Greenside School was only one of many areas of development to be focused on in the years 1993/4/5. If, as has emerged from this study, some aspects of the curriculum are more difficult to access than others, with different strategies being required to facilitate change, the feasibility of taking on such a raft of disparate areas for development is questionable, and difficulties inherent in these expectations should be acknowledged by external inspection.

Little (1990) referred to the 'action on all fronts' that was required from schools:

> For teachers to work often and fruitfully as colleagues requires action on all fronts. The *value* that is placed on shared work must be both said and shown. The *opportunity* for shared work and shared study must be prominent in the schedule for the day, the week, the year. The *purpose* for work together must be compelling and the task sufficiently challenging. The *material resources and human assistance* must be adequate. The accomplishments of individuals and groups must be recognised and celebrated. (p. 188)

A school's culture, the way in which it has chosen to do things, may be able to provide and support such action on all fronts. While this action may be successful in facilitating change in some areas of the curriculum, this study has shown that the task may be **too** challenging, for subject-specific reasons, for a school's well established and generally successful ways of working to be sufficient. Major issues relating to the innovation itself, in this case 'Using and Applying Mathematics', need to be considered, and it may not be possible for the school to tackle these issues on its own, particularly at a time when disagreements over the teaching of mathematics have risen to the top of the national agenda.

10. 6 Conclusion - Ma1 within the wider context

This study has focused on primary mathematics within the wider context of educational reform. Since the beginning of the research, (the context for which was described in Chapter 1), education has increasingly become embroiled in political debate and reforms have continued to be initiated or discontinued with little creditable evidence upon which to base decisions. Not the least of these areas of controversy has been that of statutory assessment, leading to the publication of results in league tables of schools. As was seen in this study, constraints of statutory assessment were regarded by some teachers as a factor militating against a focus on the process-based aspects of mathematics.

With the introduction of the slimmed-down version of the National Curriculum in 1995 (DfE, 1995), it was intended that there should be a moratorium of five years on further changes to the curriculum. Relief was short-lived, however, for the classroom teacher, as issues of pedagogy, so recently portrayed as an area where schools were to be enabled "to retain flexibility about how they organise their teaching" (NCC, 1989), began to enter the arena. Quality of teaching was to be increasingly focused on in OFSTED inspections (OFSTED, 1995); whole class, group or individualised approaches were praised or problematised according to individual points of view. For a variety of reasons these issues focused heavily on mathematics.

What had been lacking since the introduction of the National Curriculum was any serious attempt to address the extent of the mismatch between the pedagogy of reform and traditional bases for feelings of efficacy in teaching mathematics, or to facilitate change by providing the means to bridge the gap that it represented. Reporting on a similar mismatch in the USA, Smith (1996) felt that "the failure to explore, identify, and build new foundations of efficacy in teaching mathematics may seriously limit the impact of the reform" (p. 387).

Teachers have not been shown an alternative basis on which build up a sense of efficacy in a new pedagogy. To make matters worse, that alternative pedagogy implied by the focus on Ma1, introduced as a mandatory part of the curriculum in 1989, is being jeopardised and undermined by recent pronouncements from authoritative sources. Although not overtly contradicting the aspects of the mathematics curriculum made mandatory as recently as 1989, this undermining can be seen firstly in an emphasis on whole-class teaching for mathematics which permits the interpretation of transmission models of pedagogy (Her Majesty's Chief Inspector of Schools, speaking on Panorama,

June 3rd, 1996), and secondly in an emphasis on the teaching of number. These emphases may result in the reinforcement of just those ideas of school mathematics which a focus on 'Using and Applying Mathematics' seeks to dispel.

It would not be surprising if primary teachers, unable to avoid the public and confrontational nature of these pronouncements, were now questioning whether the mathematics National Curriculum, with its explicit intentions as regards the process aspects of mathematics, was, in fact, suitable for whole-class teaching. Future pronouncements on teaching style, perhaps themselves reinforced through OFSTED inspections, may not help teachers to form the positive notions of the merit and worth of 'Using and Applying Mathematics' necessary to promote its permeation through the mathematics curriculum. The challenge to existing pedagogy that Ma1 represents may be dissipated by the conflicting messages emanating from central government, and, in the current situation, teachers may not be prepared to devote both individual and collective efforts to developing their understanding of it further.

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Appendices

Appendix 1.

Notes on schools visited during the selection process

Sands Primary School **29.6.93**

Large three form entry First school with Nursery. 18 teachers altogether. 6 classroom assistants. Well staffed - have benefited from LMS and have increased classroom support. Head very complimentary about staff, and maths co-ordinator in particular. They are mostly long-serving, altogether a very stable staff with a few young and inexperienced teachers. Head very keen not to encroach on teachers' own time, and prepared to cover classes himself to provide time for interviews etc.

Head is an ex-maths co-ordinator. Present co-ordinator has been in the school for 7 years. Both she and a younger teacher are working with a BEAM group. Before the NC they used Fletcher, but, having felt the need to bring what they were doing in line with the NC, they have now changed to New Curriculum Maths, which is linked to the 5 attainment targets. The maths work done in the school is predominantly from the scheme, and the school scheme of work is based largely on this scheme.

The maths co-ordinator has worked hard to support teachers, indicating strengths rather than weaknesses. The same applies to her feeling that AT1 needs attention, but she has not raised this specifically as area in which staff are failing. One teacher has approached her for help with AT1, and she herself feels that the scheme does not address AT1 as fully as it should, ie that activities which say they cover AT1 and other ATs are not all there is to know about AT1. She feels that many teachers are lacking in confidence in maths.

She envisages the development of Ma1 through 'topic work' which I interpreted as maths topics. Assessment, differentiation and progression in Ma1 were all mentioned as needing attention, but there was no mention of children's behaviours or teaching styles.

Both Head and co-ordinator felt that the research would encourage reflection and aid the development of the maths. The co-ordinator in particular was realistic about the role of the researcher, and saw the need to explain that role carefully to teachers and get their co-operation.

The maths development is ongoing on the school's development plan, as are the other core subjects. Any special focus next year will be on the 'peripherals', art, music, drama. On the development plan it is stated that the co-ordinator will use non-contact time to develop AT1, and assess how the scheme is working and being used. She will use the strategy of working alongside other teachers in the classroom.

There was no offer to show me round the school on this visit. There was a strong feeling that staff should be consulted carefully on all issues, and I am therefore going back to talk to the staff briefly at a staff meeting about the research.

Castle Street Primary School **2.7.93**

Large 2 form entry primary school in 3 decker Victorian building. Wide ethnic mix and two Section 11 support teachers. Also considerable number of statemented children. Was shown round by Head and Maths Co-ordinator. There was a lot of maths on display in the school, with some teachers contributing to this more than others.

Head and co-ordinator had both been there about 2 years and obviously felt that the maths needed building up from a low base. Last year a maths working group had worked on the maths policy and this had been presented to staff and accepted. They were now using BEAM record sheets. Culture of the school, according to the Head,

was that maths was not given a high degree of importance, and teachers did not have a lot of confidence in maths. They had established this year that four and a half to five hours per week should be spent on maths. There was a wide variety of ways approaching maths in the school.

They had worked on maths through a maths working party and through workshop curriculum meetings last year, with the co-ordinator leading sessions on, for example, subtraction, addition, looking at progression, with examples of activities. Co-ordinator had been a maths adviser before returning to the classroom, and Head also had a maths background. Both were keen to see an improvement in the maths. The school had been using Nuffield before the development of the maths started, and the aim was to broaden out from here so that Nuffield was used as one of many resources, including a school bank of activities to be built up during the next year.

There was no history of collaborative planning in the school before this Head came, in fact not a great deal of attention paid to planning at all. The Head had initiated a new planning system, based on PoS statements to encourage differentiation and awareness of levels and more focused planning. He had started preparing folders for staff with the maths PoS. and was continuing for the other subject areas. The Head was hoping to be able to give non-contact time for joint planning.

Curriculum development would take place through curriculum meetings and with the co-ordinator being released to work in classrooms. Problems of progression in Ma1 had arisen in workshop sessions during this year. The co-ordinator would welcome someone to act as sounding board for ideas on Ma1. It was clear that a great deal of thinking was going into curriculum development and maths in particular.

The school felt tense, with over 400 children: it was mentioned that the new Head had had to deal not only with curriculum problems but considerable behaviour problems when he came. Head and co-ordinator seemed keen to be involved in the research and seemed prepared to agree to involvement without consulting the staff.

Greenside Primary School **5.7.93**

Large 2 form entry Primary school with Nursery (3 years old). 450+ children in all. Attractive setting in pleasant grounds. Spacious building with good sized classrooms and wide, well-used corridors. Mixed catchment area socially, but very small ethnic mix, one or two children per class, widely differing origins.

Head has been there 2-3 years. Maths co-ordinator is Nursery teacher. She has two maths at A level, and Maths and Education as main subjects in teacher training. Has been at the school about 8 years. Head is also an ex maths co-ordinator. There are 15 class teachers and a Deputy without a class.

Maths has been identified on the school development plan with other areas ie not exclusively. Staff have requested help with AT1. Maths development has also been ongoing this year.
4 points for development were detailed on the plan:

1. Evaluate and bring to attention existing investigational ideas

2. Review any new resources available with a view to extending school resources, particularly for AT1

3. Collect a school bank of ideas

4. Review progression of skills used for investigative/practical work throughout the school.

There is whole-school discussion of curriculum development, including what goes into the school development plans. Two working groups for maths have been established, inf and jun., who work with the co-ordinator. They will work initially on point 4, the progression of ideas, and then come to whole-staff meeting. This progression will be broadly across all ATs and will form the basis of a scheme of work, to be started next year. Classes plan at the moment in year groups.

Peak scheme is used as the core scheme. This was bought 2/3 years ago at the request of the staff for a basic structure. They also have some Ginn left over, and more recently have purchased some Maths Chest materials. Approaches to maths are very varied, with some teachers using the scheme hardly at all, and some to a considerable extent - more of these probably in the Juniors. There is a mix of more and less experienced teachers, and there will be two probationers next year.

Curriculum working groups and whole-staff meetings will be used to develop the maths, as well as involving advisory help. Development of role of co-ordinator is also envisaged, with time allocated to work alongside teachers. Once role developed, may be reassigned to another co-ordinator with maths co-ordinator becoming Head of Nursery/Early Years (not sure which).

Was shown round the school at lunchtime. Very friendly and unstressed atmosphere - everybody friendly and helpful. School display looked outstanding, but this is a week after a full OFSTED inspection so is no doubt looking its best. Not an awful lot of maths display, but what there was looked interesting.

Was given a copy of the maths policy document. Existing scheme of work being re-written as now out of date. School is reasonably resourced for maths, but money is generally tight. Parents welcomed and often come in to help. Described by co-ordinator as supportive.

The Head had herself been involved in some action research into the role of the maths co-ordinator, when she was one, for a diploma, and was very interested in the research, and sensitive to the effect on teachers. Suggested that I would need to go away and think about them, as well as vice versa. The Head and co-ordinator would talk to the staff about the research. Time for interviews within school time was not mentioned, but I think there would be flexibility here.

Queens Road Primary School **6.7.93**

2 form entry First School and Nursery, 360 children in all. 10 class teachers, 4 NNEBs, one part-timer, one floating teacher (Deputy) and Head. Attractive two-storey building with new (2 years) purpose built Nursery and accompanying parents' room and resource room. Classes very full, even Reception have 35; low ethnic mix in school. Parents welcomed in to help - they would like this to happen more.

The Maths co-ordinator is also the Deputy Head, and he attended a 20 day course this year. He found it useful, but less in the area of subject knowledge than in other areas. The school is staffed by experienced teachers on the whole, with one NQT who has contributed in a major way to the maths development. Approaches to maths vary.

There is a history of collaborative planning in the school. Maths has had a high profile for 2 years and is again on the development plan for next year. A maths working group has formulated a maths policy document and the scheme of work is to be built up next

year. A recent Inset on 'Using children's books for maths work in the early years' has just been undertaken and was regarded as successful by Head and Deputy. There will not be a lot of time for the co-ordinator to work alongside teachers next year, as he will spend at least 2 days each week in the Nursery, obviously a priority for development.

The school gave up Scottish Primary Maths recently owing to dissatisfaction with approach to practical work, and the identification of major gaps, and they have bought Maths Chest - a major outlay on the scheme and necessary resources. This was done after full staff discussions and viewing several schemes. It has proved organisationally difficult for some teachers, and the co-ordinator described the success of its introduction as 'varied'.

School planning revolves around a fixed set of cross-curricular topics established after extensive whole-school planning, and having been amended as necessary over the last two years. The co-ordinator envisages building the scheme of work from these cross-curricular topics initially, and looking for mathematics not covered through these topics.

Ma1 was not specifically mentioned until I asked about it. Co-ordinator assumed that development of Ma1 would be ongoing with the development of the scheme of work. It seemed that staff had not specifically asked for help with Ma1.

I was shown round the school by the co-ordinator (who was then rushing off to a Headship interview - NB). There was a quiet, friendly atmosphere; the children were forthcoming. There was not a lot of maths work on display, but practical work going on in small groups.

The co-ordinator was keen to establish the needs of the research and the time requirements, and felt that some non-contact time might be available for interviews. Both he and the Head felt that teachers could be consulted informally, and that both sides needed to go away and think about it. They both felt that the school would benefit from the research in terms of focusing thinking about mathematics.

Aynham Primary School **8.7.93**

Large two form entry primary school, 420+ pupils, situated in very attractive suburban surroundings. Parents reasonably affluent and very generous towards the school. Also welcomed in considerable numbers to help in the classrooms.

Deputy head has been at the school for 20 years and is the maths co-ordinator. A younger teacher is starting a 20 day course next year (September) and it is hoped that she will be able to share the responsibility for maths, especially for the younger children.

The school made a major outlay on Ginn mathematics 2-3 years ago and on a great deal of equipment to go with it, having changed over from Fletcher because of the continual need to supplement it. The co-ordinator feels that it is taking time for the staff to get used to the new scheme, as it requires a different way of working. Children are now working individually through the Ginn materials, and equipment is therefore needed in the classrooms so that children can use what they need when they need it. Teachers have become more aware of the range of attainment working in this way, and the school needs more material for high attainers beyond the Ginn 6+. They use DIME materials and other problem solving activities already.

They are reasonably satisfied with the Ginn. The co-ordinator did not mention the parallel nature of the books for UAM. The school runs a lunchtime Maths Club, and

has won a local maths competition (mainly problem solving in style) several times (Mathemania).

The school has a written policy and scheme of work produced by the co-ordinator and agreed by the whole staff. This details the use of Ginn as the core scheme, but emphasises the need for supplementary work and the importance of the role of the teacher in using a scheme. Problem solving and investigative activities are mentioned as being an essential part of children's mathematics.

I was shown round the school by the Deputy head/maths co-ordinator. The environment is very favourable, with a pond, and both wild and cultivated gardens which are looked after by the children. The design of the school includes large 'messy' areas outside each pair of classrooms for children to work in groups - usually with a parent. Each classroom has a computer and printer.

As far as co-operation with the research is concerned, the co-ordinator feels that there would not be a major push on maths next year (from September 1993), as the teacher on the 20 day course should have time to complete it and reflect upon it. He envisaged the year after as a possible time for co-operation and was happy to be contacted again next year to discuss this possibility.

Copy of school scheme of work was given.

Appendix 2.

Notes on Fellside and St. Mary's schools

Notes on visit to Fellside Primary School **28.6.93**

The purpose of this visit was to get useful feedback from the school about how their focus on maths had proceeded last year, and what they felt had been the outcomes. It had already been established on the telephone that their focus would not be mainly on maths during the next school year, although they viewed the review of the maths as ongoing to a certain extent, with greater attention being paid to AT1 next year.

Fellside Primary School is an 8 class primary school with a Nursery in a large three decker Victorian building, in an inner city area with a racially mixed population including a recent increase in the number of Moroccan children. The school population is now considerably smaller than the building was originally designed for, with the result that the school has a really spacious feel, with several old classrooms being used as resource rooms, head's and deputy's rooms etc, and recent decoration and display giving a light and colourful impression. I was not able to see individual classrooms as I was not shown round the school.

The starting point for their maths development had been a request by the school for a maths inspection, over a year ago. The school had realised that maths had not been touched for a very long time, and several members of staff, mostly in the Juniors, were dissatisfied with the Nuffield scheme which they were using. They felt that they were not really coping with the National Curriculum, according to the Head and the Deputy.

The development of the maths had taken the form of staff meetings to discuss maths, with input from advisory staff coming into the school. Partially on the recommendation of the Inspector, and partially on the basis of the maths co-ordinator (and Deputy Head)'s research, they decided to change the commercial scheme, and equipped the whole school with the Cambridge scheme, which is now being used extensively. The school scheme of work, which was discussed by the staff and written up by the co-ordinator, was mainly number (they didn't talk in terms of attainment targets at all) and used Cambridge as a base with references to other materials including Nuffield.
They have also decided to devote the first hour of the morning to maths in all classes, and feel that this has improved both quantity and quality of the maths.

Both Head and co-ordinator felt that the maths had moved on in terms of teacher confidence, willingness to take on new ideas, provision for, and awareness of, differentiation.

Although having a written scheme for their number, they had not really considered Ma1 at all.

At the end of this year, the Deputy Head is handing over as co-ordinator to a young teacher, in her third year of teaching, who did maths as a main subject in her degree at [...]. The new co-ordinator is interested in the area of Ma1, and feels that it is being recorded as attained, before the maths being 'used and applied' has been understood. "You can't use and apply, until you've learnt it.' Using and applying was talked about very much in terms of investigations and mental maths as well as 'using and applying'. The new co-ordinator wanted to build up a bank of investigative activities, and spoke about the advantages of differentiation by outcome using this sort of activity.

The next stage of the development of the mathematics is envisaged as a broadening out to other areas of maths eg measures through maths topic development.

The Deputy Head had been able to work in other teachers' classrooms over the course of the past year, as she does not have a class, and is hopeful that this strategy will be adopted for the new co-ordinator. The Deputy Head seemed particular aware of the needs of teachers who were not confident in mathematics.

The school has recently been re-inspected for maths, and both the school and the Inspector feel that significant progress has been made.

Characteristics of the year's focus

Initial decision that maths needed attention, by some or all of the staff.

Involvement of Inspector and advisory staff

Collaborative action to write a scheme

Change of commercial scheme

Strategy of co-ordinator working alongside teachers being used

Input from a 20 day course

Appreciation that more time needed

Awareness of feelings of inadequacy about mathematics

Decision to give the first hour of the morning to mathematics

Future action

Deputy Head to send maths scheme of work

Arrangement to return to the school during the next school year to discuss the progress of this year's development.

Follow-up visit to Fellside school **7.7.94**

The purpose of this visit was to see how the postholder viewed the development of mathematics over the past year, focusing particularly on strategies which had been successful.

The postholder was new to the post in September 1993, having taken over responsibility for the maths from the Deputy Head. She has a strong maths background and feels confident in her both her own mathematics and her mathematics teaching.

During the year the school had purchased Mathshare, a commercially produced guide to the National Curriculum by Muriel Chester. This is produced for Levels 1-5 and aims to:

suggest a framework for learning
offer broad experience guidelines and activity suggestions
expand the AT programmed of study statements
provide class checklists for recording experience and/or attainment

'in a format that enables schools and teachers to make it their own personal file by referencing activity suggestions to the resources particular to the their school'.

They are finding this useful, and have purchased this instead of producing their own scheme of work. They have also purchased Heinemann KS2 Assessment folder. They are still using Cambridge as the basis of their work, less so in the Infants than in the Juniors.

The postholder felt that the most valuable strategy in encouraging the permeation of Ma1 through the maths curriculum, was in her regular visits to classes. She had managed to maintain these throughout the winter term, and part of the spring term, but time had not been available in the summer term. She had worked particularly with probationers in the Infants, working with a group herself, and discussing the work with the teacher afterwards. She promoted an investigative approach in her work with the children. The only year group that she had not worked in was Year 6, where she felt that there was not as much Ma1-type work as in other years (she consulted a Year 6 teacher who had just come into the room on this point, and received confirmation of this). Apart from this year group she felt that Ma1 was really incorporated in all the maths work, and was not viewed as a separate entity. A particular value of this classroom based work, she felt, was the value of being able to talk to teachers on the spot when something arose, rather than in a disconnected fashion at a meeting.

As a school they had really pushed mental maths, and she felt that teachers had realised that maths was not just pages of sums.

She was pleased that other teachers in the school felt able to come to her for advice, and did so frequently.

The school is adopting a new approach to planning from September 1994 in which all teachers' plans will be open to view, and pinned up on the staffroom board. In this way co-ordinators will be able to have an overview of planning in their areas, and can monitor what is planned. The school mathematics planning aims to visit content each year, rather than leaving some topics to a two-year visit.

The whole school has maintained the hour per day on mathematics in the morning, and the postholder felt that this made more maths happen. She also felt that both children and teachers found it easiest first thing in the morning.

The school collects together a portfolio of work from all the various classes; there is not much collaboration involved in this - staff just give the work to her.

The postholder felt that the staff had moved on in terms of making all their mathematics teaching more investigative. Young teachers coming from college seemed to find it easier than those well established in their careers before the introduction of Ma1. She was anxious that Ma1 should not be subsumed in the new document, as having it separate had forced people to think what they were doing.

Plans for next year:

Following a full inspection during the year, it had been suggested that they should share good practice by videoing each other teaching. The postholder would conduct some INSET using this idea at the beginning of the September term.

A maths week was planned for next week, with one day being open to parents.

Postholder intends to carry on next school year with the strategy of going into other teachers' classrooms to work on maths alongside them.

Follow-up visit to Fellside School **11.7.95**

The purpose of this visit was to return to the school, a year on, to talk to the postholder about the development of mathematics in the school, with a particular focus on strategies which appeared to have been successful.

The postholder, having completed two years as maths co-ordinator, is leaving the school, and will be replaced by an acting postholder.

The postholder's main focus during the year has been the writing of a scheme of work for mathematics which would incorporate the new curriculum and provide what was needed in terms of the requirements of OFSTED. She has, in fact, produced two documents, the first as she saw the need for the school, and a second which has had to be adapted to the requirements expressed by the borough.

Her first scheme of work has been organised in work for each year group, focusing on what was appropriate for the average child. For each year group she has produced an A4 size sheet on which a number progression was ongoing from the beginning to the end of the year. This was accompanied by blocks of work from the other attainment targets, with each attainment target being visited twice each year. She has also reproduced the whole of the Ma1 programme of study statements ranging right through the levels on each year group sheet. She explained that she felt strongly that teachers should be aware of what they were aiming at in terms of the later levels, and should not, for example, think that generalising was only appropriate at later levels. Children in Reception should be beginning to make generalisations, however simple. She has indicated in the blocks of work which part of Ma1 would fit most appropriately with the work being done and could be focused on in a certain section of work. She has also produced a chart of all the blocks of work to avoid clashing resources. She has referenced the work to the Cambridge scheme throughout, and considered that theMathshare file purchased the previous year was an excellent source of more detailed examples of work to fit in with the scheme.

She has some anxieties about requirements from outside eg the LEA consultants had suggested that certain parts of Ma1 should be focused on at different ages and that the detailed reference to the commercial scheme was not required. However she was anxious that these feelings should not be reported. She has also written an adapted scheme of work. She was not sure which of these two would be adopted by the school, but felt strongly herself that if the school scheme was not linked carefully to the Cambridge, teachers would revert to just using the commercial scheme.

She has presented her scheme of work to staff and it has been well received - not surprisingly, she said; if someone presents you with a complete scheme, you're not likely to disagree until you've had time to work with it. It remains to be seen what the take-up will be.

She has done all this work entirely on her own, except for some brief but useful discussions with the Deputy Head, the previous maths co-ordinator. She was irritated by the lack of computer facilities in the school. Her own was not compatible with the school software, and there were no facilities therefore for up-dating and amending the document she has produced.

She has also conducted some school-based Inset on Ma1, some of it based on a course she had been to, using a metre cube. Another session was based on patterned wrapping paper. She was anxious to stimulate discussion through staff doing the activities themselves, and seeing possible ways to develop activities for their own classes.

The postholder has been able to continue her work in other classes throughout the year, slightly erratically because of sickness, etc, but nevertheless frequently enough for her to feel that this strategy has been really helpful. She works with a group in the classroom, and feels that it gives her opportunities to talk to teachers in a non-threatening situation, to monitor what is going on in other classrooms, to suggest appropriate resources, and to engender discussion.

The school has continued to devote the first hour of the morning to maths, and the postholder thinks that most teachers are happy with this; there is some flexibility. This high amount of time spent on maths is now being questioned by the new Science postholder, so discussions are to be held about this time allocation, and about looking at cross-curricular links.

The sharing of planning documents is ostensibly happening - cards of plans are up in the staffroom, but she is not sure how well it is being maintained, or how useful it is. She herself has access, with the Deputy Head, to maths books collected at intervals from each class. This has become a routine exercise and provides a useful basis for monitoring presentation of work, encouragement of different ways of recording, pace of working through the scheme books, etc.

She feels that Mal is being incorporated into the mathematics in most classes, though there are some differences in approach and teaching style. There is an acceptance of the importance of children trying their own methods; this has become part of the ethos of mathematics in the school.

The postholder herself is leaving teaching temporarily to go abroad and develop her French language. She is at present in the middle of a Masters degree at the Institute of Education which she will finish, and very much enjoys the academic work.

Visit to St Mary's RC Primary School **15.7.93**

The purpose of this visit was to get useful feedback from the school about how their focus on maths had proceeded last year, and what they felt had been the outcomes.

This school had had an almost complete change of staff two and a half years ago, with a new head, deputy and 6 members of staff. Only two class teachers had remained during the changeover. The maths co-ordinator, who came at that time, was new to the post of maths co-ordinator, and started a 20 day maths course in September 1992.

She used the input from the 20 day course to guide the development of the maths through curriculum meetings.

The maths in the school has had Nuffield as a core, and this continues to be the core, with the addition, this year, of the teachers' books from Cambridge and some examples of pupils' books. This was at the request of the teachers who felt the need of greater security. The school have decided to buy a set of the pupils' books for each class, and the co-ordinator is very aware of the need to monitor the use of the scheme. At the moment, teachers select to fill their own needs, and she is anxious that they should retain this approach, and also use the wide range of materials which she has provided.

During 1991-2 the following curriculum meetings were held:

Investigations

Staff looked at and tried out a variety of investigative activities. They worked in groups, each group containing a range of year groups. They also discussed how to extend activities, and turn activities into investigative activities.

Working out a Policy

The co-ordinator presented ideas for discussion, using the Non-Statutory Guidance, and she then wrote up the results of the discussion.

Presenting the Policy to staff.

Resources meeting

The co-ordinator arranged for all the maths equipment to be collected centrally, and involved all staff in looking through the equipment, and writing down ideas for activities which fitted different ATs for which the equipment could be used. Lists were made of essential equipment for each classroom. and lists of available equipment were given to each teacher. The co-ordinator felt that this had been a successful activity, but they had attempted to do too much at one time, and it would have been better to spread the activity over several sessions. However, she did feel that it had been helpful for staff to become more familiar with the full range of resources available, and this had provoked ideas for activities.

A maths resource area was set up, with equipment clearly labelled, and a wide variety of maths ideas (Kensington & Chelsea Maths Team publications, Spectrum maths etc) out on display and to be borrowed.

Algebra

Each teacher brought samples of algebra work to the meeting and these were looked at across the whole age range. The co-ordinator regarded this as a valuable exercise, as this was an area in which staff felt insecure, and she made the range of samples into a bound book which could be borrowed from the resources area.

Mental mathematical activities

Record keeping

Probability

Another session which involved trying out activities, looking at the PoS and ATs, and sampling probability activities, which were also bound as a book to be used as a resource by teachers.

After this series of meetings, the staff together compiled a list of priorities for the next year. These were:

Record keeping,
Regular sampling of children's work
Self-assessment for children
Organisation of computer disks (this was done with the help of the maths adviser, and each teacher was given a list including descriptors of the software.
Schemes of work

In the Summer of 1992, the staff discussed different ways of going about writing schemes of work, and each put forward ideas. With the advice of the Inspector, they considered activities as introducing, consolidating or investigating ideas, and looked for a range of these activities in each AT.
They focused first on number, as this was the area in which staff felt most secure.

During 1992-93, development proceeded at a slower pace as other areas of the curriculum took priority in the school (and the co-ordinator's post was reduced from B to A - all allowances are temporary according to what has priority in the school at any one time). Curriculum meetings generally followed ideas from courses or co-ordinator's meetings which the postholder had been on.
The putting together of the scheme of work is now the priority, and the co-ordinator is looking at ways of tackling that task at the moment. This will involve looking at where AT1 comes in to all activities.

The co-ordinator has been able to spend one hour a week in other teachers' classes and regards this as a very valuable strategy for development, particularly as she included planning and evaluation sessions with the teacher concerned.

The co-ordinator is highly regarded by the Head, who feels that she has made a valuable contribution to the maths development. She herself feels that change has taken place, with teachers more prepared to try new activities, to include a wider variety of activities, and to talk more about mathematics.

Characteristics of the maths focus

Major change of staff leading to feeling of making a new start

Input from 20 day course, and other maths courses at the PDC

Input from adviser and inspector

Strategy of co-ordinator working in classrooms, including the planning and evaluation of these sessions.

Thorough planning of and preparation for curriculum meetings

Working from areas of strength and familiarity eg resources, number

Collaborative development through curriculum meetings

Critical approach to commercial schemes (by the co-ordinator and some of the staff)

I asked if I could visit the school towards the end of next year, to see what progress had been made with the Scheme of Work.

Follow-up visit to St Mary's school **8.7.94**

At the beginning of the year, teachers gave the postholder their ideas for what should be included in a scheme of work. By this time, they had decided on a format which most people were working in. The postholder put these together, making some additions which she thought reflected the absence of activities or resources from teachers' repertoires. A meeting was held at which teachers indicated where they thought there were gaps, eg. Year 1 needed more number activities. The scheme of work is produced in a booklet for each of key stages 1 and 2. Each year group has a section, but each of these sections contains work from several levels to try to ensure differentiation. There are suggested activities, resources and assessments at each level. Levels therefore overlap throughout the year group structure.

The postholder felt a sense of anti-climax after the scheme of work was completed and was not sure if teachers were using it. They were still using the Cambridge scheme, and she was anxious that they were using this more than the scheme of work.

Apart from the meeting on the scheme of work, there had been no other maths meetings during the year, as other areas of the curriculum had taken priority.

The school had a full inspection in February 1994, and the scheme of work was completed for this, as was a revision of the maths policy. The report encouraged teachers to use the school scheme of work, indicating that they felt that maths was 'on its way' in the school. The inspectors also stressed the value of teachers working alongside each other, and although the postholder felt that this was beneficial, there was not much of this going on, and she herself had not had the non-contact time to do this regularly throughout the year. She had taken a group of high attainers from a Year 2 class, and had worked at integrating Ma1 with the work she did with this group, but as she was not working in the classroom she felt that it was not easy to pass on ideas.

She said that teachers still felt that Ma1 was difficult to address and to assess, and that few teachers included Ma1 in their planning. She has no overview of maths planning, and would not feel able to ask for this, unless it became part of all postholders' roles. She could not really assess whether teachers were incorporating Ma1 in their teaching, although they were encouraged to do so. She felt that she needed to pass on the knowledge which she gained from co-ordinators meetings, but that this was difficult without regular maths meetings. They needed to look at the strands of Ma1.

A strategy that had worked well at the school was to ask teachers to bring pieces of children's work to staff meetings, and discuss these. Staff did not feel threatened by this approach. All staff had marked the pilot SATs and this had been a useful exercise.

A whole-school development this year was a shared approach at KS2, in which all teachers did handwriting and mental maths first thing in the morning, all worked in similar books and had adopted a similar way of setting out work. This was to be extended to KS1 next year.

Priorities for next year:

To work on a scheme of work for the Nursery with the Nursery teacher

To look at the strands of Ma1

To work alongside other teachers if this is possible

(Design Technology has been selected as the main area for development next year.)

Follow-up telephone interview to St Mary's school co-ordinator 15.12.95

Contact made with the school in July 1995 revealed that the maths co-ordinator had been on maternity leave and would return to the school in October. As she is only part-time, and as the term was drawing to it's usual frantic Christmas close, I arranged to telephone her at home to discuss how she thought things were going.

Having completed a school scheme of work during the previous year, the postholder was monitoring its implementation and the use of the Cambridge scheme. Shortly before she left to take maternity leave, she attended a co-ordinators' course run by the borough which was promoting ideas about how to incorporate the new version of the curriculum. She was advised to prepare a framework for the maths which identified blocks of different maths work to be done at different times of the year, with number running throughout, and help was given on the course in doing this. This was not how the school scheme of work was designed, so what she started to do was to incorporate ideas from the school scheme of work and the Cambridge into the LEA format. This is being trialled in the school. On the whole, teachers like this format, as it gives them clearer ideas about when and what to do - it is more prescriptive than the scheme of work. It covers Year 1-6 and is done in key stages. She is now 'fleshing it out' with more detailed activities and resources.

Since October, she has been working three days a week and has no class responsibility. She covers Section 11 language teaching - right through school from Nursery - and is also working on mathematics with the Year 3 class, as well as giving some help to the Year 2 teacher who has not experienced SATs before.

She feels that Ma1 is still something of a problem. Teachers are able to give evidence of activities where it is involved, but are less able to identify which strand, or to plan for it. The intention, with the new maths framework is to go back over the number sections with a view to organising it better, and incorporate references to Ma1. She is encouraging the build-up of folders of ideas of activities which incorporate Ma1 and which can be kept in classrooms.

She is hoping to help the Nursery to build up ideas for a mathematics programme and is getting some help with this from the borough and from another school. She feels lack of experience of the Nursery is hampering her, but is using her Section 11 language time in the Nursery to get a clearer picture of what the possibilities are.

In terms of moving on the maths development, it seems that certain things have been important:

1. Her time in classes (with Year 3 teacher) to develop ideas eg about differentiation, show ways of incorporating Ma1.

2. A more prescriptive maths curriculum document.

3. Provision of suitable activities for teachers to use and respond to.

She commented, referring to the latest curriculum document, that it was like reinventing the wheel, and was finding it an onerous task to incorporate previous document and commercial scheme into new framework.

Appendix 3.

Research activities undertaken at Greenside School

Phase 1 September 1993 to February 1994

Month	Classrooms visited	Teachers interviewed	Meetings attended
September 1993	**Nursery** **Reception** (Fieldnotes 1)		
October	**Year 3** (jobshare) **Year 4** (Fieldnotes 2) **Year 5, Reception** (Fieldnotes 3) **Year 3** (Fieldnotes 4) **Year 1 (two classes)** **Year 2 (two classes)** (Fieldnotes 5) **Year 6, Year 3** (job-share) **Year 5, Year 4** (Fieldnotes 6)	**Informal interview with Ruth, MC,** (Fieldnotes 7)	**Staff meeting** (Fieldnotes 2) **Maths Meeting (I)** (Fieldnotes 4)
November	**Year 6** (Fieldnotes 8)	**Madeleine - R** (Int. 1) **Linda - Year 1** (Int. 2) **Lesley - Year 2** (Int. 3) **Liz - Year 6, JC** (Int. 4) **Mike - Year 5** (Int. 5) **Karen - Year 3** (Int. 6) **Tania - Year 1** (Int. 7)	**Meeting with Head** (Fieldnotes 10)
December	**Reception** **Year 4** (Fieldnotes 13)		
January, 1994		**Ruth, MC** (Int. 9) **Meg - Year 6, WG1** (Int. 10) **Diana - Reception** (Int. 11) **Mary - Year 4, CC** (Int. 12) **Valerie - Year 4** (Int. 13) **Tessa - Year 2, IC** (Int. 14) **Ruth, MC** (Int. 15) **Eric - DH** (Int. 16)	**Inset day School Development Plan** (Fieldnotes 14) **Maths Working Groups** (Fieldnotes 14) **Staff Meeting** (Fieldnotes 15) **Staff Meeting** (Fieldnotes 16)
February		**Carol - Year 3** (Int. 17) **Ursula - Year 5** (Int. 18) **Head - Laura** (Int. 19)	**Maths Meeting (I)** (Fieldnotes 20) **Meeting w. Head** (Fieldnotes 22) **Maths Working Group** (Fieldnotes 23) **Adviser's meeting w. maths co-ord.** (Recorded in Fieldnotes 24)

Table 3.2 Research activities undertaken at Greenside School

Abbreviations used: DH, Deputy Head; MC, maths co-ordinator; CC, curriculum co-ordinator; IC, Infant co-ordinator; JC Junior co-ordinator, KI, key informant; WG1, maths working group April '93 - March '94; WG2, maths working group April '94 - March '95.

Appendix 3 (contd.)

Phase 2 March 1994 to May 1994

Month	Classrooms observed	Teachers interviewed	Meetings attended
March	**Eric, DH, KI, with Year 4** (Obs. 1)	**Conversation with Eric, DH, KI, re Obs. 1**	**Maths Meeting (J)** (Fieldnotes 25) **Maths Meeting (J)** (Fieldnotes 29)
April	**Mary , CC, KI, Year 4** (Obs. 2) **Eric, DH, KI, with Year 2** (Obs. 3)	**Conversation with Mary, CC, KI, re Obs. 2**	
May	**Madeleine, KI Reception** (Obs. 4) **Tessa, IC, Year 2** (Obs. 5)		**Meeting with Head** (Fieldnotes 34)

Table 3.2 (contd.) Research activities undertaken at Greenside School

Phase 3 June 1994 to July 1994

Month	Classrooms observed	Teachers interviewed	Meetings attended
June	**LEA maths adviser in:** **Year 6** (Inset Notes, Year 6) **Year 3** (Inset Notes, Year 3) **Year 1** (Inset Notes, Year 1) **Year 2** (Inset Notes, Year 2) **Year 4** (Inset Notes, Year 4) **Reception** (Inset Notes, Reception)	**Conversations with:** **Tessa, IC, re Obs. 5** **Madeleine, KI, re Obs. 4** **Eric, DH, KI, re Obs. 3**	**Maths Working Group** (Fieldnotes 35) **Inset Meeting with LEA maths adviser** (Inset Meeting Notes)
July			**Informal meeting with Head** (Fieldnotes 38)

Table 3.2 (contd.) Research activities undertaken at Greenside School

Abbreviations used: DH, Deputy Head; MC, maths co-ordinator; CC, curriculum co-ordinator; IC, Infant co-ordinator; JC Junior co-ordinator, KI, key informant; WG1, maths working group April '93 - March '94; WG2, maths working group April '94 - March '95.

Appendix 3 (contd.)

Phase 4 September 1994 to November 1994

Month	Classrooms observed	Teachers interviewed	Meetings attended
September	Maths co-ordinator in: Reception (Co-ordinator obs. 1) Year 2 (Co-ordinator obs. 2)	Conversation MC re Co-ordinator obs. 1 and 2 (Fieldnotes 41)	Maths Working Group (Fieldnotes 40) Maths Working Group (Fieldnotes 42) Staff meeting (Fieldnotes 43) Maths Meeting (J) (Fieldnotes 44)
October		Informal interview with Meg, Year 6, WG1/2 (Fieldnotes 46) Olivia - Year 2, WG2 (Int. 20) Nell - R, MC (Int. 21) Ruth, KI, (Int. 22)	Inset Meeting Data Handling (Fieldnotes 45)
November	Informal visit to Reception class (Fieldnotes 48)	Una - Year 5 (Int. 23)	Meeting w. Head (Fieldnotes 47) Meeting w. Head (Fieldnotes 49)

Table 3.2 (contd.) Research activities undertaken at Greenside School

Phase 5 December 1994 to March 1995

Month	Classrooms observed	Teachers interviewed	Meetings attended
December	Eric, DH, KI in Year 6 (Obs. 6)		Meeting with Head (Fieldnotes 50)
January	Diana, Reception (Obs. 7) Nell, MC, KI, Reception (Obs. 8) Mary, CC, KI , Year 6 (Obs. 9) Carol, WG2, Year 3 (Obs. 10) Tessa, IC, Year 1 (Obs. 11) Una, Year 5 (Obs. 12) Madeleine, R, KI, (Obs. 13) Olivia, WG2, Year 2 (Obs. 14) Liz, JC, Year 4 (Obs. 15) Olwen, Year 3 (Obs. 16) Valerie, Year 4 (Obs. 17) Tania, WG2, Year 1 (Obs. 18)		Inset Meeting SDP (Fieldnotes 51) Staff Meeting (Fieldnotes 52) Maths Working Group (Fieldnotes 54) Staff Meeting (Fieldnotes 55)
February	Karen, Year 3 (Obs. 19) Carolyn, Year 6 (Obs. 21) Mike, Year 5 (Obs. 22) Lesley, Year 2 (Obs. 23)		
March		Mary, CC, Year 6 (Int. 24)	Staff Meeting (I) (Fieldnotes 56) Staff Meeting (I) - Levelling Meeting (Fieldnotes 58) Meeting with Head (Fieldnotes 59)

Table 3.2 (contd.) Research activities undertaken at Greenside School

Abbreviations used: DH, Deputy Head; MC, maths co-ordinator; CC, curriculum co-ordinator; IC, Infant co-ordinator; JC Junior co-ordinator, KI, key informant; WG1, maths working group April '93 - March '94; WG2, maths working group April '94 - March '95.

Appendix 3 (contd.)

Phase 6 April 1995 to December 1995

Month	Classrooms observed	Teachers interviewed	Meetings attended
April			
May		**Liz, JC, Year 4** (Int. 25) **Olwen, Year 3** (Int. 26) **Tessa, IC, Year 1** (Int. 27)	
June		**Tania, WG2, Year 1** (Int. 28) **Una, Year 5** (Int. 29) **Karen, Year 3** (Int. 30) **Diana, Reception** (Int. 31) **Nell, MC, Reception** (Int. 32) **Olivia, WG2, Year 2** (Int. 33) **Valerie, Year 4** (Int. 35) **Carol, WG2, Year 3** (Int. 36)	
July		**Madeleine, KI, Reception** (Int. 37) **Eric, DH, KI,** (Int. 38) **Mike, Year 5** (Int. 39)	**Meeting with Head** (Fieldnotes 65)
. . .			
November			**Meeting with Head** (Fieldnotes 66)
December		**Informal interview with Nell, MC** (Fieldnotes 66)	

Table 3.2 (contd.) Research activities undertaken at Greenside School

Abbreviations used: DH, Deputy Head; MC, maths co-ordinator; CC, curriculum co-ordinator; IC, Infant co-ordinator; JC Junior co-ordinator, KI, key informant; WG1, maths working group April '93 - March '94; WG2, maths working group April '94 - March '95.

Appendix 4.

Vignettes of key informants

Ruth (MC, KI)

Mary (CC, KI)

Eric (DH, KI)

Madeleine (Reception, KI)

Ruth - Maths Postholder and nursery teacher, Early Years Co-ordinator

This vignette is based on data from three interviews (Ints 9, 15 and 20), fieldnotes, collected between September 1993 and November 1994 and two short observations in classrooms.

When I first went to Greenside School in September 1993, Ruth had been a member of staff at Greenside for 10 years, and maths postholder for 8 years. She had taught a wide range of year groups, starting in Year 5 and moving down to Reception, and thus has experience in both junior and infant sections of the school. although she felt she was now out of touch with the Juniors. She took on responsibility for the setting up and running of the Nursery in September 1990 (concurrent with the arrival of the new Head) and the post of Early Years Co-ordinator shortly afterwards.

Ruth's educational background includes two Maths A levels, and she took maths as a main subject in her teacher training. She feels reasonably confident in her mathematical subject knowledge, but less confident in her role as co-ordinator, leading the mathematics development in the school. Ruth's professional development also includes an Early Years Certificate, obtained after part-time study at Froebel college while she was a Reception teacher at Greenside.

Ruth has built up the Nursery from scratch and is enjoying her role as nursery teacher. She has a calm and measured approach with the children, and aims to provide an environment which encourages independence and self-reliance. She considers it important that children should learn at an early age to make decisions for themselves and be able to both find and replace any materials or apparatus that they need.

When the idea of my research was suggested in July 1993, Ruth was one of the members of staff who had misgivings about my presence in the school, as she realised that her involvement would be greater than others. Her approach, however, once the decision was made jointly by the staff to invite me into the school, has been one of unfailing co-operation and open-ness, and after the first six months of the research she indicated that she now felt less threatened and had got used to my presence in the school (Fieldnotes 28).

Both Ruth and the Head were anxious about the implementation of Ma1 throughout the school, and were happy that staff had agreed that the development of this area of mathematics should form part of the activities given priority on the School Development Plan starting in April 1993. During the following term, it was realised by the staff that, before they could discuss a progression for Ma1, a progression agreed upon by all members of staff was necessary for all areas of maths. They were at this time relying on a pre-National Curriculum document, in conjunction with the National Curriculum documents themselves. Ruth, who had been responsible for IT as well as maths before Meg (Year 6 teacher and the other member of the maths working group) took this over, had produced such a progression for IT, and she was asked to do something similar for maths.

Ruth felt considerably daunted by the task of preparing this progression, but started work on it in the summer term of 1993. She felt very strongly that the staff should be closely involved in the preparation of this document, and was proposing to work through feedback from meetings with Infant and Junior sections of the school. During that term also, she began, with the co-operation of Meg, the other member of the maths working group, to collect together a bank of ideas for activities which encouraged the implementation of Ma1 (mainly of an investigational type) and to make these available to staff. She was also engaged in a review of all the maths resources in the school, including the distribution of scheme materials (Peak mathematics) and the allocation of equipment

to individual classes and, centrally, to the re-organised resources room. As part of the plan adopted to encourage the development of 'practical and investigative maths' (as it had initially been specified on the School Development Plan) the maths adviser, Eva Farley, conducted a twilight session in the school in June 1993, at which activities promoting the development of Ma1 were suggested for various age-groups. The response to this session had appeared to be positive, but later, Ruth felt that the results had not been long-lasting (Int 9) and it had not been possible to arrange another meeting because of the pressures of an imminent Ofsted inspection (July 1993).

Ruth has therefore been engaged on a two-pronged task - preparing the maths progression and trying to find the most appropriate way of developing Ma1. Her approach to the first of these was to prepare a levelled framework based on teachers' own ideas which had been requested at the end of the previous term and which had been returned to her. The first Infant maths meeting began to put these ideas together and discuss agreement and disagreements (Fieldnotes 4). This work continued during the Autumn Term, 1993.

At the beginning of January 1994, reactions expressed to the previous year's development at the INSET Day to discuss the next School Development Plan caused both Ruth and Meg considerable feelings of failure, as the decision was made to carry forward Ma1 on to the next year's plan, with teachers obviously feeling that they still did not know how they should be implementing it.

> *I felt, what had we done in the year? And Meg and I thought we'd worked quite hard getting some of it off the ground, and obviously it wasn't enough, so ... so I was disheartened, but you go on.* (Int 9)

Ruth felt that one of the reasons for the lack of development was that she hadn't been able to organise the meetings that she wanted (the Juniors seemed always to have a prior commitment). She also felt that her own lack of non-contact time had meant that she couldn't get in to classrooms to help people.

During the first two interviews (Ints 9 and 15), Ruth expressed many anxieties about the way in which she was tackling both aspects of her task, and the relationship between them. It seemed that she had not really clarified her own ideas about the implementation of Ma1 although she felt she was laying the foundations for some process skills in the Nursery. In January/February she had the added burden of a student in the Nursery who needed a great deal of support and supervision, and eventually decided to leave, even though this was her final teaching practice. Ruth felt a great deal of responsibility for this, even though she was convinced in her own mind that her judgements had been sound.

Ruth felt the responsibility of co-ordinating maths across the whole school to be a heavy one. She felt that other teachers had not shown much interest, and it had been left to her and Meg. (This feeling was confirmed by Meg in her interview, 10.) She did not feel sufficiently confident in full staff meetings to express these feelings and to request time to go into classrooms for monitoring and development, which she considered necessary to promote the development of Ma1.

In terms of the progression which she was developing (and which was taking a great deal of her time), Ruth's worries centred on her own feelings of inadequacy (was she missing things, was it clear to the non-mathematician?) as well as her own clear ideas of the purpose of the progression as a working document (it should have a levelled format to aid

differentiation and get away from the idea of work for one year group; it should incorporate a progression for developing the skills of Ma1)

She found this latter task very difficult to put down on paper. In terms of the development of Ma1, she admitted to being unsure about her own understanding of Ma1, feeling that she had a sense of when coverage was not adequate (just doing the examples), but was less able to be specific about ways of working. She was very aware that most of the teachers at Greenside were even more unsure about what Ma1 meant, clinging on to ideas of 'investigational activities' or 'they're doing it all the time, really' as solving the problem for them.

> *You can just put down that they're experiencing UAM all year, but that's not the answer, because being able to get the rulers out themselves, or whatever, is not using and applying maths!* (Int 9)

She also recognised that teachers were frightened of open-ended activities, not knowing how far to let children go on, being worried about their own subject knowledge. She was reflecting herself on a common cry of the teachers at the school, that you had to do the 'basics' first, and was wondering about the provision of activities for the younger children in the school. She felt that teachers had to be shown that it could work,

Ruth appeared to have an excellent working relationship with her advisory teacher, Eva Farley, and felt able to ask for advice and help. She had a high opinion of how she performed her role.

> *I chatted to her about what I'd been doing, and I said I really needed her to come and look at what I'd done so far.*
>
> *She's a very good advisory teacher, she really does get things going when she comes in.* (Int 15)

Ruth described her meeting with Eva in late February as a chance for her to talk freely with the adviser listening. She felt that the time (a whole morning) had 'flown by'. This meeting succeeded in boosting Ruth's morale, as Eva was very complimentary about the work she had done so far, and fully supported her decision to keep to a levelled format. They were able to discuss ways of including Ma1, and opted for an approach in which opportunities for Ma1 would be identified wherever appropriate within the topic planning framework (another school planning document into which the progression was to be slotted), with three specific investigations for each year group identified to facilitate assessment. Activities would also be included in the topic boxes. Both Ruth and Eva were collecting suitable activities, and hoped to moderate these together.

The importance of this positive reinforcement of her work was evident in her bearing and manner, and she was boosted further (if also terrified!) by being asked to talk about what she had been doing to a meeting of the group of maths co-ordinators which she attends. Her increase in confidence appeared to carry over into the meetings which she led with the Juniors later in the term (Fieldnotes 25 and 29), at which she was able to express opinions firmly, and give advice where subject knowledge was lacking.

By Easter 1994, Ruth seemed to have reached a positive stage in how she viewed the maths development, having survived a period of anxiety and low morale earlier in the term. She said she was beginning to see real possibilities for the maths development (Fieldnotes 24), and had organised dates in June for the adviser to come in to the school

on three consecutive days to work in year groups with all teachers, and, a week later, to conduct a session on assessment of Ma1. This strategy had been adopted to answer the perceived need for teachers to 'see that it works' in the classroom with a whole class of children, rather than just a group.

By early May, the news that Ruth was pregnant was made public, to be fairly closely followed by Meg making the same announcement. Plans were quickly made to cope with these eventualities. Ruth was to relinquish her maths post to a new member of staff when she took maternity leave in November. She was also to relinquish her role as Nursery teacher for her last six weeks at school, so that the children would be able to have a supply teacher for a full year, rather than changing over part way through the year. This would give her the opportunity to spend time in every classroom in an advisory role, and she clearly relished this opportunity.

The end of June saw the class-based INSET sessions from the adviser, followed by a whole-staff meeting. Teachers varied in their engagement with these activities and with the meeting afterwards. Many issues were raised, but many still left unanswered.

At the beginning of the Autumn Term, 1994, Ruth had finished the maths progression, with the approval of both Infant and Junior staff, and was looking towards linking this into the topic framework - all of which had to be done before she left at half term. Her in-class support sessions proved a major disappointment. As she had to take on the role of first day cover teacher, being a 'floating' teacher, her sessions were in fact very limited, and by chance it happened that some teachers received help on a fairly regular basis, but other missed their session every week. In the last interview which I held with her just before she went on maternity leave, Ruth was able to reflect in a very open way about what she felt were her successes and failures in facilitating the development of Ma1 throughout the school.

She realised that her time out of the Nursery and in classes before she went on leave had given her time for reflection, and she felt that her own ideas about how to incorporate Ma1 had developed. She had either worked on teacher's suggested activities and tried to open these out, and show teachers how she was doing this, or she had taken in an investigative type of activity herself, or she had worked with one of the activities suggested by the adviser. I asked whether she would have felt confident about doing these sorts of activities before the whole-school focus on Ma1 began, and she said that she realised that her own confidence had grown, even thought she had always been critical of a textbook-based whole-class approach, with differentiation mainly by speed of work.

In relation to the whole-school maths development, she felt that the writing of the progression and the topic framework (with which she felt considerable satisfaction) had been a heavy burden which had to some extent distracted her from getting to grips with Ma1. However she did admit to avoiding the issue to some extent.

> *Yes, we've sort of worked through the other bits, and keep skirting round that bit, but that's the bit that's left now, actually sorting out ... a) some investigations that we have to do and b) how we really start to do AT1, so it's still ongoing.* (Int 20)

Ruth was not optimistic that the strategy of providing a bank of resources would prove successful, on the evidence so far, with very few teachers consulting it. She was aware of some changes related to the implementation of Ma1 within the school, affecting certain teachers. She had been asked by a Year 1 teacher to involve her in an investigative

activity in the classroom, although the need to cover for sickness had precluded this activity on the day. The Year 6 teachers were sending much more open-ended activities home for homework, and this was initiating discussion with parents. Looking back over the past eighteen months she felt that:

> *Perhaps there's more of an openness to the idea, and a willingness to try. I still think there's a lack of confidence or an understanding, but there's lots more practical work being done.* (Int 20)

Ruth expressed some relief at relinquishing the maths post. She had found the last year difficult, not really knowing how to clarify teachers' uncertainties, but also feeling slightly resentful that some teachers at any rate were making little effort themselves. She was looking forward to a new challenge when she returned to the school, although she did not yet know on which area of the curriculum this would be focused.

Mary **Curriculum and Assessment Co-ordinator**
Year 4 teacher (1993/94)
Year 6 teacher (1994/95)

This vignette is based on data from two interviews (Ints 12 and 24), observations (Obs 2 and 9) and fieldnotes, collected between September 1993 and March 1995.

Mary is an experienced and confident teacher who seems to relish a demanding and interesting post within the school. She was appointed by the Head in January 1993 following a teaching post abroad. She is a member of the Senior Management Team (Head, Deputy and Curriculum and Assessment Co-ordinator) and is responsible for curriculum and assessment development and co-ordination. She also takes responsibility for music in the school, and plays the piano for assemblies and concerts, as well as training the choir.

She feels that it is part of her post to be an example of good practice to other teachers and thinks seriously about her own practice. She feels that she is a strong classroom teacher, and is building from a position of strength (Int 12). She participates frequently and with authority in staff meetings, but defers to others when they are leading meetings.

She feels that the mathematics in her previous school in Germany was much stronger than at Greenside, and is keen to promote more investigative and open-ended work in the school. She has chosen to develop AT1 in her own teaching, as part of her own personal appraisal programme. She described the need to understand AT1 in greater depth, and to be able to define more clearly both which strands of the attainment target children are using during an activity, and how she can develop the assessment of these strands. She feels that she does a considerable amount of open-ended work, and encourages children to develop strategies and report back on their mathematics.

During the first interview Mary mentioned some activities which she thought children should be engaging in, relating to AT1. In terms of the communications strand, Mary wants children to be showing and explaining their results and their working, seeing from other children's work that there are different ways of getting to an answer. In terms of how they work, she encourages independence in the choice of apparatus and equipment and likes children to have experience both of working on their own and working together.

In encouraging these ways of working, the teacher needs to be open to children's alternative methods and provide an environment which aids choice and independence.

She feels quite strongly that the role of the teacher includes the modelling of strategies, to give children ideas as well as encouraging them to develop their own strategies for working through problems. Finding the right questions to ask to promote development was a difficult part of the teacher's role.

Mary does not share the view, expressed by some of the teachers interviewed, that behaviour difficulties, or a lack of maturity in the ability of children to organise themselves, can be seen as a reason for not incorporating AT1-type work in their mathematics. She feels that it is *'just up to your own teacher organisation'*, and would work with one group at a time, with other children in the class engaged in activities which need less teacher intervention. She also feels that children who find it difficult to engage in this type of work can be provided with activities at which they are going to succeed fairly quickly, so that they can gain confidence. Again, she feels, this is down to the teacher's own teaching ability.

Describing two children who were at different levels in AT1, she compared one who saw patterns very quickly, did a lot of work in his head, and enjoyed pursuing a problem, with another who found it difficult to apply what he knew, couldn't see a pattern quickly and was unsure as to how to record it. Both children, she thought, were at the same level in the rest of their mathematics work.

Mary was keen to participate in classroom observations of her maths lessons. She feels that this observation has helped her to analyse her approach to AT1, and is keen to discuss the observations both before and after the sessions. She is encouraged to find from the observations that the pupils are exhibiting some of the behaviours which she feels are part of AT1, and that she is encouraging these by her teaching strategies in the classroom.

At the SDP meeting in January 1994 (Fieldnotes 14) Mary pointed to the difficulties of assessing AT1 and added her voice to the call for its inclusion in the next school development plan.

The school, under Mary's leadership, undertook a major planning exercise during 1994. Subject co-ordinators provided subject input to a topic framework which incorporated all National Curriculum subjects and linked them wherever possible to a half-termly topic for each year group. Ruth's maths progression, which had been developed with teacher input during 1993-94, provided a basis for the maths, and further meetings were held to slot both topic-related and on-going maths into this topic framework.

In order to encourage the teachers at the school to incorporate more activities involving AT1 into their practice, it had been suggested by the maths adviser that investigative activities should be slotted in to the topic framework to provide activities for assessment. This task was passed on to Nell, when she took over as maths co-ordinator in November 1994, and is being completed during the summer term of 1995. Mary was instrumental in the selection of an investigative activity for the levelling process which forms part of the school's internal work on assessment.

The school year 1994/95 has been an extremely busy one for Mary, both personally and professionally. The autumn term was considerably disturbed by an accident which meant that she was off school for several weeks. She was also seeking promotion, and was selected for a Deputy Headship at a school some distance away to start in April 1995.

Before she left in March, Mary participated in a second interview (Int 24), at which she was asked to respond to some of the beliefs and ideas which she had expressed eighteen months previously and to comment on her own and whole-school progress in the area of AT1.

In terms of her own development, she feels that she had made considerable progress, particularly in her planning for AT1. She is now picking up on the different strands and looks for suitable activities to go with different areas of maths identified in her plan. She feels more personally confident in what to look for in activities, what mathematics is involved, and feels in a stronger position to help other teachers. She has worked on children's recording techniques and sets aside particular occasions for assessment where children are asked to work independently.

She has had to work very hard to make this progress, and readily admits that during the past few months she has not had any time to do this. She is appreciative of the time required to read up, to research activities, to reflect on practice which she made a priority,

and acknowledges that other teachers may not have had that time. Her progress, she feels, is based on her own personal focus on AT1, rather than coming from strategies employed by the school.

In terms of the whole-school focus on AT1, she can identify a change of attitude, an admission of difficulties, a greater willingness to talk about AT1, and was made particularly aware of this at the levelling meeting she led, at which the Junior teachers were particularly forthcoming. She feels that the presence of the researcher in the school has raised the profile of this part of mathematics, and has personally valued the feedback from observations.

Mary feels that AT1 is now part of her maths practice. It is difficult to establish quite to what extent she sees the implementation of AT1 as being through investigations, and how much she sees it permeating through all her maths teaching. At a staff meeting in January (Fieldnotes 55) she was keen to broaden the discussion from the 'using and applying mathematics' working group into a wider focus than just investigations. On the other hand, the activities in her classroom, and described by her (the circuit mornings (Interview 24)), would fall mainly into the category of investigations. However, she indicated that she was employing different approaches in her descriptions of her daily maths activities and emphasised the importance of alternative methods of doing calculations, valuing children's individual contributions.

Eric Deputy Head, Greenside school

This vignette is based on data from interviews (Ints 16 and 38), observations (Obs 1, 3 and 6) and fieldnotes, collected between September 1993 and July 1995.

Eric is an experienced teacher with a background in secondary history and PE teaching, and subsequently in special education, both MLD and EBD schools. He came to Greenside in January 1992, his first post in a primary school.

He plays an important management role in the school and is consulted frequently on management matters. He seems to be responsible for timetabling, resources, supervision of students and NQTs, provision of non-contact time for teachers (in conjunction with Head), special needs organisation and duty and supply rotas, as well as being a member of several working groups, the Senior Management Team (Head, Deputy and Mary), and the Management Team (Head, Deputy, Mary, Liz, Tessa, Ruth).

He has his own room at one end of the junior upper corridor, and does not spend a lot of time in the staffroom. He seems to have a quiet but authoritative presence in the school, and a friendly and informal relationship with members of staff. He appears to have an excellent working relationship with the Head, and clearly admires what she has done in the school since she came. He has no class responsibility, but is tightly timetabled, much of this time being spent in other teachers' classrooms, releasing them for non-contact time.

During 1993/94 Eric was frequently asked by teachers to do mathematics investigations when he was covering their classes. This had been the case for about a year and a half. He thought this was not only a response to teachers' feelings of lack of confidence in this area of maths, but also a reflection of the emphasis put on investigations by the borough over the last few years. From the whole school point of view, he thought that it was problematic that investigations were being regarded by teachers as a discrete part of maths, the implication being that they could be done as 'one-off' activities by someone coming into the classroom for single sessions.

As he has no maths background, other than the small amount he did at college (*'light years away!'*), he felt inadequate at that time about his own abilities to carry out maths investigations, and began to read around the subject. He shared the anxieties of other teachers about this area of mathematics and there were still many things that he was unsure about. In his 'peripatetic' role he wondered what relationship the work that he did with pupils had with the mathematics they were doing with their class teacher, and with the skills that they already had Although he felt that the pupils enjoyed investigations and had a good time, he wondered what they are actually achieving. He was also unsure about whether new things could be taught through investigations.

During the first interview, Eric mentioned several behaviours which he thought children should be exhibiting, relating to AT1. He was anxious that pupils should be able to apply the skills which they had and *'fathom things out'* for themselves, mentioning real-life situations here. He also wanted them to be going through a process of looking at and analysing a task: looking for patterns in numbers, looking for patterns in the recording of their own way of working. Pupils should discuss their work with each other, come up with their own theories and evaluate their work.

Eric believed in teaching for AT1, and felt that it should be purposeful, not accidental. He thought that children needed help in structuring their own evaluation of what they had done. He felt that children could all have input into investigations, an advantage of this

type of activity, but that the outcomes for lower attaining children were more likely to be in the practice of skills.

Some of the teaching strategies which he described related closely to the behaviours he was keen to encourage. The teacher should be encouraging pupils to come up with their own theories and evaluate how they were working. Strategies used needed to be made explicit, as did the search for pattern and the identification of suitable ways of recording. He recommended a teaching approach which stopped frequently to discuss with children how their work was progressing.

As far as the whole school development of this area of mathematics was concerned, Eric favoured classroom support as the most valuable form of intervention, and was keen to see the effects of the visits of the maths adviser in the summer term. He was aware of teachers' insecurities, particularly about the difficulty of predicting outcomes in more open-ended situations.

During the course of the next school year Eric agreed to be observed on three occasions. His life had become increasingly busy during the second half of the autumn term in 1994 with the absence of Mary, the curriculum co-ordinator, for several weeks. His responsibility for special needs also demanded more of his time, following new guidelines on procedures and documentation needed for charting the progress of all those identified as requiring extra help of some kind.

He was always extremely helpful in providing opportunities for the observation of lessons and appeared to find the write-ups of these sessions useful, but opportunities for the discussion of these was limited by his extremely busy timetable.

The observations revealed that Eric was practising many of the strategies which he considered to be part of the necessary repertoire for the implementation of AT1. Pupils in the classroom generally appeared relaxed and comfortable in an atmosphere which encouraged questioning and discussion and showed evidence of being systematic in their ways of working and recording, discussing their work with others and explaining it to the whole class. Eric frequently modelled strategies and encouraged pupils to build on other pupils' methods, and check whether their results were sensible These teaching strategies and behaviours were more evident in situations which Eric regarded as 'investigational'. When he was conducting an introductory activity on measurement with a Year 2 class, his approach was not so open, and the work planned did not leave so many decisions to the pupils.

The second interview with Eric in July 1995 (Int. 38) followed a year in which his contact with classes had not involved AT1 to any great extent, but a wider mix of subject areas. Eric was not able to say whether teachers were themselves conducting more investigational activities, but felt that the writing of these into the topic planning document had been important in increasing the pressure on teachers to provide opportunities for all children to experience this sort of work. The monitoring of this situation, for which there would be opportunities in the next school year, would clarify the extent of implementation. In terms of his own progress with AT1, Eric felt that he had learnt through activities which had failed, or not gone as planned, giving him a basis for reflection as to possible causes for this failure.

He felt that investigational activities were still regarded generally in the school as something 'bolt-on', rather than 'built-in' to work on the other mathematics attainment targets, although the relationship might well be implicit rather than explicit, he felt. It

seemed from the observations that Eric himself was still clinging to some extent to this view of investigations being in some way 'separate', although he clearly felt that this was not the whole story - that AT1 should be explicitly related to other work in maths. Having no class and having been teaching relatively little maths in the past year, he felt that he was hampered in the amount of reflection and review of AT1 that he could engage in. However, he made it plain that he was still thinking about and working at this area of mathematics. He was not satisfied that he was being systematic enough in his assessment of AT1, and felt that this was an aspect that he should work on.

Madeleine Reception teacher - curriculum responsibility History and Geography 1993/4

This vignette is based on data from interviews (Int 1 and 37) and fieldnotes, collected between September 1993 and July 1995. Also on two classroom observations, Obs 4 and 13.

Madeleine is in her 7th year of teaching, with three years' experience in another school. She has experience of Years 1 and 2 and now Reception. She has an air of quiet confidence, of seriously thinking things out, and of being quite definite in her views. In the classroom she is reassuring and gentle, but quite firm with the children. By the time of my second visit to her classroom (Obs 4) the class had acquired a settled and task-oriented feel, with children seeming confident and relaxed.

In her interview, Madeleine expressed firm views about getting the foundations for learning right at an early stage, and thus avoiding problems later on. Recording should only begin when it was suitable for the children, and an apparent ability with formal work could mask lack of understanding. She stressed assessment by observation. She talked in terms of a stage-by-stage approach to learning, with children being given enough time to feel secure about concepts, language, etc before moving on.

Madeleine mentioned several aspects of AT1 throughout the interview as part of a general description of her teaching. She seemed to feel that AT1 included the ability of children to follow instructions, to be logical and to reason things out. She felt that children should be talking about and explaining what they were doing and making decisions about what was suitable or available for them to use to help them with their mathematics.

She felt that teachers needed to lay the foundations for AT1 skills early. They needed to organise the room to aid choice and independence so that children could make more decisions for themselves. Teachers might also need to extend and adapt possible activities for different ages and attainment levels. She stressed the value of teachers assessing by listening to children's explanations.

Madeleine was initially hesitant about making time for me to come and observe some mathematics in her classroom, but seemed happy about it in retrospect, and volunteered to talk about it after she had read the observation notes which I fed back to her. During the hour in which I was in the classroom it seemed to me that children within the group I was observing were exhibiting several of the behaviours which she was keen to encourage. They were working methodically and checking their results and considering whether they were sensible. They were using alternative approaches, making predictions, and describing and explaining the work being done. One child could select the appropriate mathematics, and the whole group which I observed carried through their task to a successful conclusion.

During my observation I noted that the children in Madeleine's class worked steadily and sensibly and appeared not to mind when other children commented on their work, or found mistakes. Children were prepared to talk about their work to a comparative stranger, to the teacher and to each other. Madeleine adopted a questioning approach, created a receptive atmosphere, and encouraged children's own contributions. She also offered strategies for working methodically. Children were challenged to go further if Madeleine thought this appropriate

Madeleine felt that some of the teachers' strategies identified in the observation were things that you take for granted as being good classroom technique. She felt that people tended to underestimate 5 year-olds, and it was nice to see them exhibiting some of the pupil behaviours which appeared in higher levels of the attainment target.

She was interested in seeing that certain specific, often very simple, comments from the teacher could encourage children to be as independent as possible, to query and question themselves, to use the apparatus and find the answer within themselves. She said that she encouraged children to share work and work together, and also to try things and not be afraid of getting things wrong. She described her whole classroom atmosphere as being geared to children working in this way, as though AT1 was a way of working.

Madeleine was involved in observing the INSET session for the Reception class, but was not present at the follow-up session. She had to supervise her children in assembly. She attended the INSET meeting with Eva Farley, but was not a major contributor to this.

The task for the children during the second observation (Obs 13) was less open, being involved with finding specific amounts of money, using 1p coins. Madeleine used references to earlier work, checking on background knowledge, before modelling strategies to help the children. She was able to reinforce one child's use of an alternative strategy to help with counting, and to build on this method when she spoke to the group at the end of the session.

The second interview (Int 37) revealed the depth of Madeleine's reflection on this area of mathematics as she came to end of two years with a Reception class, which had been new to her, and anticipated moving on to Year 3.

She wanted to qualify one or two of the statements made in her first interview, feeling now that the ability to follow instructions was a statement made right at the beginning of the Reception year which might not apply so much further up the school. She also felt that the area of children making decisions about what was suitable and available and teachers organising the room for choice and independence was a difficult one. With very young children, she felt that they should be as independent as possible but that there should still be an underpinning of structure.

Over the past 18 months Madeleine feels that she has come to a different view of 'Using and Applying Mathematics', seeing it as a complex process that goes on day after day after day. She now expects more from the children themselves rather than thinking of it as very much on her shoulders. She feels that 'Using and Applying' doesn't just happen, there's a huge amount of preparation and thought needed on the teacher's part to develop it and a huge thought process for the child as well. The children get more involved and get used to a certain way of thinking about things, and this has to be built up day in and day out. She has noticed that children can become very independent and free thinking fairly quickly, and ask far more questions.

From a whole-school point of view, Madeleine feels that teachers are talking about AT1 more. The work that she sees in classrooms seems to be less formal and there are more investigations going on. The writing of the maths progression in meetings has made her think about maths more, and the focus in the school on AT1 has also made her more aware that this is something she should be working on. She feels the need for more common understanding between teachers on the assessment of AT1. She feels that the context of an activity has to be considered carefully before you make judgements. She had enjoyed the levelling meeting, where the Infant staff all discussed the same activity, but still wasn't sure that they would all be making the same judgements.

Madeleine feels that the greatest influence on her over the last two years has been coming to terms with learning about Reception teaching. You are the base line, as a Reception

teacher, and you're aware of providing a sound basis for future work. Madeleine clearly feels that this is a great responsibility

Appendix 5a.

Greenside coding framework

BM	beliefs about mathematics	
	MS	maths as such
	MP	maths as part of something else
	P	progression within maths
	PPF	progression practical -> formal
	MPF	maths as practical/formal
TM	time spent on maths	
OM	organisation for maths	
	PD	provision for differentiation
	AAt	attitudes towards attainment
DcC	difficulties/strengths - curriculum	
EM	enjoyment of maths	
PM	planning/recording for maths	
CP	children's participation in/attitudes towards maths	
TTM	teachers talking about maths	
TS	teaching strategies for maths	
BL	beliefs about learning	
ASc	attitudes towards scheme use	
TJ	teachers' feelings about how they are being judged	
C	career	
	MC	maths at college
	ME	maths experience
AM1	attitudes towards Ma1	
	Ma1?	what is Ma1?
	W/W	who and when for Ma1?
	Behavs	what should children be doing?
	Teach	teaching for Ma1
	Style	teaching style for Ma1
	PQ	personal qualities
	Adv	advantages of investigational/ open-ended activities
	DcMa1	Difficulties with Ma1
	Pl	Planning for Ma1
AM	aspects of management	
	FE	freedom of expression
	CS	channels of support
	RCon	response to constraints
	PPD	provision for prof. development
	RPost	role of Postholders
	MS	management structures
	AStaff	appreciation of staff
	CStaff	consultation of staff
	HI	heads role and intervention
	DD	day to day running
FM	feelings about management	
FS	feelings about the school	
DcS	difficulties/strengths - self	
PT	professional talk	
PR	professional relationships	
RR	reflection/review	
SR	social relationships	
	FSD	factors making social relationships difficult
PA	parental relationships/influences	
MD	maths development - school	
	RIn	responses to Inset
	SAd	support from the adviser
	MDiffs	difficulties
	Dev	development needed
	Str	strategies
	Pro	progress
CX	context	
Ass	assessment	
Res	research issues	
R	resources	
CoOu	constraints from outside	

Appendix 5b.

"Aspects of management"

These statements are summarised or quoted from interviews and fieldnotes.

Freedom of Expression (FE)

Ability of teachers to admit difficulties	Eric, DH/KI
Attempt to create atmosphere in which people can admit difficulties	Head
People more ready to talk about things than two years ago	Head
Positive atmosphere on SDP INSET day, all comments taken seriously and treated with respect	F'notes 14
No jibing or negative remarks on SDP INSET day	F'notes 14
Deputy voicing difficulties felt by several members of staff as his own	F'notes 14
Teachers feel free to make comments on professional matters in meetings	F'notes 16
Anxiety about expressing views on use of scheme	Linda Mike
Anxiety about expressing views on own role as shadow coordinator	Lesley
Endorsement of apparent school policy on the encouragement of collaborative work	Olwen
Ruth expressed doubts about the topic approach to curriculum development in year groups	F'notes 15
Teachers feel free to express ignorance about certain mathematical terms in meetings	F'notes 29
Teachers unwilling to express opinions openly in meeting	F'notes 51
Few comments in whole group staff meeting	F'notes 52

Channels of Support (CS)

Huge support with difficult class	Meg, WG1/2
Head coping with a difficult child while Meg had a break	F'notes 12
Newly qualified teachers go to Ruth for advice with maths	Karen Tania, WG2
Newly qualified teacher has regular meeting with Eric, and can ask for advice and help	Karen
Newly qualified teacher can consult other year group teachers	Karen
Valerie asked Ruth for advice on maths after the Junior Maths Meeting, having changed age-groups recently	F'notes 25

Appendix 5b (Contd.)

Response to constraints imposed by management (RCon)

Everyone accepts that frequent meetings are necessary	Ruth, MC/KI
Acceptance of demands for display before Christmas	F'notes 10
Staff prepared to be on at least two working groups, and some on more	F'notes 14
Acceptance of taking notes on staff meetings every time	Ruth, MC/KI
Apparent acceptance of considerable demands re curriculum planning	F'notes 15
Staff work very hard and are often involved in several meetings per week at lunch time and after school	F'notes 25
Energy and enthusiasm displayed in discussion on INSET day	F'notes 14
Negative comments about meeting demands	F'notes 31 F'notes 32
Tessa explains to Nell why Head did not intervene in assembly	F'notes 58

Provision for professional development (PPD)

Day release for maths coordinators' meeting	Ruth, MC/KI
IT adviser visiting school on several occasions	F'notes 23
Technology adviser visiting school	F'notes 10
Ruth released for morning to see maths adviser	Ruth, MC/KI
Daily diary reveals that teachers are frequently out on courses	F'notes 26
Regret at having no regular non-contact time because of role as nursery teacher	Ruth, MC/KI
Dates fixed quickly for visits from adviser	F'notes 28

Role of Postholders (RPost)

Feelings of responsibility attached to post of curriculum coordinator	Mary, CC/KI
Relishing of greater involvement as coordinator	Tessa, IC
Coordinators need overview of planning - difficult to have one	Ruth, MC/KI
Extension of coordinators' roles envisaged to include monitoring and help in classrooms	Head
Coordinators consulted frequently by other teachers	F'notes 4
Acceptance of the authority of others	F'notes 4
Ruth able to take strength from role as maths coordinator and put across her points strongly in meetings	F'notes 4
Feeling of isolation in role	Ruth, MC/KI
Nell opens meeting, clearly in leading role as co-ordinator	Nell, MC

Appendix 5b (Contd.)

Management structures (MS)

for SDP INSET days

Moved away from situation where just Head and Deputy made decisions about the school development plan	Ruth, MC/KI
Got things done on INSET day	Meg, WG1/2
INSET day showed how much had been achieved last year	Meg, WG1/2
Aimed slightly smaller this year	Meg, WG1/2
Way of addressing school development plan very successful	Tessa, IC
Building on successful running of INSET day last year	Head
Structure of day with short bursts of time on clearly identified tasks seemed very successful in maintaining focus and concentration	Fnotes 14
Efficient running of day, keeping to time	Fnotes 14
Head appeared uneasy with how the day had gone	Fnotes 51

working groups

Small working groups work well	Meg, WG1/2
Some working groups assumed to have level of expertise and responsibility given over to them - roles allocated	Meg, WG1/2
Working groups seem to give people the confidence to speak in meetings	Fnotes 15
Working groups give teachers confidence	Fnotes 19
Success of working groups reflects ability of head to devolve responsibility and not see school as "my school"	Fnotes 19
Important to provide time and reporting back procedures for working groups	Fnotes 19
Administrative and ancillary staff present on INSET day	Fnotes 14

Appreciation of staff (AStaff)

Expressed appreciation of work of curriculum coordinator	Head
Pleasure at increased level of cooperation from staff at this year's Inset day	Head
Complimenting staff on hard work in staff meeting	Head
Curriculum coordinator complimentary about work done by staff	Mary, CC/KI
Conclusion of junior maths meeting with appreciation of value of Ruth's work	Liz, JC

Consultation of staff (CStaff)

Not willing to agree to research until staff consulted	Head
Ensuring that teachers finding visits of researcher to classrooms	Head
Head consulted staff as matter of course on researcher's presence on Inset day	Head
Consultation of whole staff before title for maths development changed	Fnotes 14
Research discussed by Head with new staff	Fnotes 39
Need to consult heads of departments when arranging meetings emphasised by Olivia	Fnotes 54

Appendix 5b (Contd.)

Head's role and intervention (HI)

Head regrets her decision for title practical/investigative maths for previous year	Head
Head doesn't attend departmental meetings in case people feel reticent and won't talk in front of her	Head
Head prepared to intervene in a meeting if she feels something strongly	F'notes 2
Good humoured but pointed remark to Mike about lateness	F'notes 14
Head decided upon level of priorities to be included in next year's plan	F'notes 14
Positive reinforcement by Head of hard work of staff during previous year	F'notes 14
Head hoping a certain decision would be made, but didn't want it to come from her	Head
Head feeling need to find out exactly what teachers are doing, not just what they say they are doing	Head
Head prepared to make decisions on what she regards as priorities	F'notes 18
Need to let people get on with things without her there	Head
Head concerned about not breaching confidence	F'notes 35
Head delegates organisation of meeting to Meg	F'notes 43
Head suggests non-intervention when a group of teachers not on task in Inset meeting	F'notes 45
Head asks to be informed if teachers not being helpful	F'notes 49
Head would need to remind teachers about identifying ATs on planning	F'notes 49
Head notices that teachers spending less time in the staffroom	F'notes 49
Reasonable expectations of staff	F'notes 52
Head covering for Deputy while he attended an interview	F'notes 58
Head feels need to have more intervention in curriculum side in view of Mary's departure	F'notes 59
Head has to cope with decision not to go ahead with 3 form entry	F'notes 59

Day to day running of school (DD)

Meetings timetabled well in advance so everybody knows where they are with them	Ruth, MC/KI
Cleanliness and proper equipment of washrooms impressive	F'notes 10
Relaxed feel emanating from office belies rigorous organisation	F'notes 10
Office knew when teacher had forgotten an interview	F'notes 11
Head early for SDP Inset day, setting out chairs	F'notes 14
Head adds Research as item on agenda	F'notes 52
School looking very attractive	F'notes 66

Appendix 5c.

"Mathematics development" (MD)

These statements are summarised or quoted from interviews and fieldnotes.

Responses to the first Inset session from the maths adviser, June 1993 (RIn)

Activities could be extended and adapted for older children	Madeleine	KI
Impressed with adviser's enthusiastic approach	Madeleine	KI
You think "Oh is that all it is then really?"	Lesley	
People optimistic after visit	Ruth	MC, KI
People asked for another visit	Ruth	MC, KI
Lots of good ideas, but you need to make sure you've identified how the maths comes out of it	Meg	WG1/2
She's very good for activities like doing prepositions - beside, behind, etc	Diana	
Really good advisory teacher. She gets things going when she comes in	Ruth	MC, KI

Response to meeting between maths adviser and Ruth, maths coordinator (SAd)

Could tell the maths adviser how she was feeling	Ruth	MC, KI
Received praise from the adviser for her work	Ruth	MC, KI
Beginning to see real possibilities for the maths development	Ruth	MC, KI

Responses to Inset Day 5.1.94 (RIn)

Felt disheartened, felt hadn't achieved anything in the year	Ruth	MC, KI
Thought that she and Meg had worked hard	Ruth	MC, KI
Need to change the title for the development to 'Using and Applying Mathematics' because teachers think AT1 means just investigations	Ruth	MC, KI
Realised how much had been achieved last year (not just maths)	Meg	WG1/2
Change in title reflects what needs to be done, not necessarily what people think needs to be done	Meg	WG1/2
Moving on from just focusing on investigations	Tessa	IC

Difficulties (MDiffs)

Coordinator/working group

Feelings of isolation	Ruth	MC, KI
Feeling that everything was being left to them	Ruth	MC, KI
	Meg	WG1/2
Hadn't had the meetings she'd wanted	Ruth	MC, KI
Hadn't been time to keep going back to staff for opinions	Ruth	MC, KI
Hadn't got as far as she'd wanted	Ruth	MC, KI
Doesn't get time to go into other classrooms	Ruth	MC, KI
Feels out of touch with what's going on in the Juniors	Ruth	MC, KI
Finds doing maths throughout the school a horrendous task	Ruth	MC, KI
There's a limit to the amount of spoonfeeding you can do	Meg	WG1/2

Appendix 5c (Contd.)

Difficulties (MDiffs)

Related to the 'maths progression' being developed		
Feels that they haven't got a good maths progression at the moment	Ruth	MC, KI
Complaint of lack of coverage in previous classes	Tessa F'notes 20	IC
Progression in Ma1 needs to be written down and this is difficult	Ruth	MC, KI
Worried about whether she has missed something in the progression	Ruth	MC, KI
Difficulty with maintaining progression in levels rather than year groups as it is in the topic format (curriculum development)	Ruth	MC, KI
Should progression have examples to make in into a real scheme of work?	Liz	JC

Development needed (Dev)

General		
Need to get a progression in mathematics so we know what we're supposed to be teaching	Mary	CC, KI
Opportunity to see other people teach	Linda	
Advice on providing differentiated activities	Karen	
Coordinator needs an overview of people's planning	Ruth	MC, KI
Coordinator needs to monitor what's happening	Eric	DH, KI
Continuity between Key stage 1 and Key Stage 2	Head	
Ma1 in particular		
Classroom based ideas to encourage independence	Madeleine	KI
The chance to try out different strategies and see what works and what doesn't	Madeleine	KI
How to assess Ma1	Mary Valerie	CC, KI
How to incorporate Ma1 in eg data handling	Mary	CC, KI
How to plan for Ma1	Mary	CC, KI
A book giving ways to access Ma1	Liz	JC
Would like the adviser to come in again	Lesley	
Need to change title from practical/investigative to UAM to get away from idea of just an investigation - a different approach needed	Ruth	MC, KI
Maths group's job to get across to people that investigating isn't all that's needed	Meg	WG1/2
Guidance on how to do Ma1-type activities with very young children	Diana	
	Tessa	IC
To see somebody gearing work to Ma1 and assessing it	Tessa	IC
Need to build up teachers' confidence that doing the right thing	Tessa	IC

Appendix 5c (contd.)

Strategies (Str)

Nobody's looking at the folder, so we need to try another way, eg having adviser in	Meg	WG1/2
Need to arrange Inset with each year group	Ruth	MC, KI
Teachers asking for someone to show them it works	Ruth	MC, KI
No good giving people books and resources - need to watch each other and talk it over	Eric	DH, KI
Hope that more thought will be given to how to support people in class	Eric	DH, KI
Decisions need to be made about putting resources into materials or into upgrading practical skill	Eric	DH, KI
Showing people by example not enough, have to be working alongside as well	Head	
Adviser working with one teacher with other year group teacher observing	Head	
Teachers have had opportunity through research to express views	Head	
Ruth using maths meeting to put ideas across	F'notes 20	
Meetings where people can pull things apart so it ends up as a workable document	Ruth	MC, KI

Progress (Pro)

Feels that beginning to be maths development in school	Head	
Beginning to feel positive about the maths development	Ruth F'notes 29	MC, KI

Appendix 5d.

"Attitudes to Ma1"

These statements are summarised or quoted from interviews and fieldnotes.

What is Ma1? (Ma1?)

Solving problems	Olwen
Solving practical real-life problems by applying knowledge	Meg, WG1/2 Eric, DH, KI
Sorting information and working things out to make sense	Meg, WG1/2
Trying to get maths into everything	Meg, WG1/2
Applying maths in technology, construction	Mary, CC, KI Carol, WG2
Has to be practical	Liz, JC
Ability to follow directions	Madeleine, KI
Ability to be logical	Madeleine, KI Diana
Ability to reason	Madeleine, KI Diana Karen
Practical maths	Linda
Maths in PE	Linda
In ordinary, everyday experiences, eg register	Linda
Children using their hands	Linda
Number manipulation	Linda
Maths in the environment	Tania, WG2
Using maths in practical activities, eg cooking	Tania, WG2
When children don't think they're doing maths, don't see it as maths	Tania, WG2 Eric, DH, KI Olwen
AT1 goes all the way through, really, doesn't it?	Nell, MC

Who and when for Ma1 (W/W)

Have to concentrate on basics first before they're ready for Ma1	Lesley Tessa, IC Meg, WG1/2 Liz, JC
What to do if they're not numerate?	Diana
Younger children less able to participate in open-ended work	Olwen Diana Carol, WG2
Lower ability pupils not really into investigating	Liz, JC Olwen
Lower ability should be given the chance to investigate and can achieve	Mike
Lower ability get practice of skills out of investigations	Eric, DH, KI
Lower ability don't like problems	Liz, JC
Investigational work doesn't reveal problems of lower attainers	Ursula
Higher attainers participate in optional investigations more	Meg, WG1/2
Higher attainers respond to a challenge	Eric, DH, KI
More able children feel confident to go ahead	Olwen
Difficult class not so suitable for investigational work - can't organise themselves	Meg, WG1/2 Ursula

Appendix 5d (contd.)

What should children be doing? (Behavs)
(Teachers did not describe all these behaviours themselves as Ma1)

Making up sequences, changing numbers round using their own series of moves	Liz, JC
Testing their theories	Liz, JC
Finding a sequence of questioning	Mary, CC, KI
Making links between different activities	Linda
Applying what they know to new situations (and other areas of maths)	Karen Nell, MC
Explaining what they are doing	Mary, CC, KI Madeleine, KI Olivia, WG2
Talking about what they are doing	Madeleine, KI Karen Eric, DH, KI Ursula
Choosing and finding apparatus	Liz, JC Madeleine, KI Linda
Making decisions about what's suitable/available (selecting materials/mathematics	Olivia, WG2 Olwen Madeleine, KI Nell Una
Organising themselves	Madeleine, KI Olivia
Choosing criteria eg for sorting	Diana
Trying to discover things	Mike
Working their way round a hurdle	Karen
Developing and using strategies	Karen
Using skills to apply and fathom things out	Eric, DH, KI
Recording ways of working (in own way)	Eric, DH, KI Una
Asking questions	Lesley Mary, CC, KI
Looking and analysing	Eric, DH, KI
Finding things out by themselves	Ursula
Coming up with their own theories	Eric, DH, KI
Looking for patterns	Eric, DH, KI
Working through things logically	Nell, MC
Gaining independence	Nell, MC
Being systematic	Nell, MC Olivia, WG2
Thinking of themselves as mathematicians	Olivia, WG2
Finding different ways of doing things	Olivia, WG2

Appendix 5d (contd.)

Teaching for Ma1 (Teach)	
Ma1 should be purposeful, not accidental/incidental	Liz, JC Eric, DH, KI
Need to set up situations where the pupils can make it open-ended	Diana
Need to lay foundations for Ma1 skills early	Diana Madeleine, KI
Need to extend and adapt activities for different ages/attainment	Madeleine, KI
Need to organise the room to aid choice and independence	Madeleine, KI Karen Ruth, MC, KI Mary, CC, KI
Need to use strategies to help children to investigate	Mike
Need to teach strategies (for doing and recording)	Mary, CC, KI Eric, DH, KI
Need to help children to structure their own evaluation of what they've done	Eric, DH, KI
Asking what would happen if	Una
Need to ask the right questions	Mary, CC, KI
Need to challenge children	Olivia, WG2
Need to encourage search for pattern	Olivia, WG2
Encourage a variety of responses	Olivia, WG2
Teaching style required for Ma1 (Style)	
Ma1 requires change in teaching style	Lesley
Need to let children find own ways	Liz, JC
Need to let children extend and have freedom	Valerie
Have to let go a little	Diana
Need more open-ended activities	EricDH, KI
Respect for children's ideas	Olivia, WG2
Need to let children realise things for themselves	Una
Personal qualities needed (PQ)	
Confidence needed to make choices and be independent	Liz, JC
Confidence needed to work collaboratively	Mike
Confidence needed to use and apply maths	Valerie
Confidence a sign of ability in Ma1	Olwen
Pupils need to be able to organise themselves	Meg, WG1/2 Ursula
Advantages of investigational/open ended type activities (Adv)	
Children enjoy investigations	Mike
Children can work at own pace to own ability	Mike
Children can all have input	Eric, DH, KI
Open-ended activities can embrace everybody	Meg, WG1/2 Mary, CC, KI
Assessment through listening to children's explanations	Madeleine, KI
Benefits of not being right or wrong	Mike
Enjoyment in talking about mathematics	Mike
Investigations can have one starting point, then go off into different areas of maths	Liz, JC
Can only get other skills through using and applying	Olivia WG2

Appendix 5d (contd.)

Difficulties with Ma1 (DcMa1)

Ma1 is difficult to teach	Lesley
Assessment of Ma1 difficult	Mike
	Valerie
Focus on content prevents Ma1	Olwen
Progression in Ma1 is difficult	Ruth, MC, KI
Ma1 statements are ambiguous	Ruth, MC, KI
Ma1 not concrete and therefore problematic for teachers	Ruth, MC, KI
Open-ended activities frighten people	Ruth, MC, KI
Difficult to predict outcomes	Eric, DH, KI
Most children don't want to think for themselves	Lesley
Children fall apart when confronted with problems	Liz, JC
	Tessa, IC
Difficult to get children to do the questioning	Lesley
Ma1 does not have priority - basic skills do	Liz, JC
Emphasis has been on teaching skills in maths	Liz, JC
Don't know what kind of open-ended question to start them off with	Liz, JC
Difficult to know if doing own work or copying	Mary, CC, KI
Children can be noisy, easy to slip into textbook quiet	Una

Planning for Ma1 (Pl)

Ma1 difficult to plan for and I am not good at it	Tessa, IC
No specific planning for Ma1	Lesley
	Liz, JC
Ma1 requires a lot of planning	Liz, JC
Always include Ma1 in planning	Tania, WG2
Planning for Ma1 through other ATs	Tania, WG2
Difficult to specify in planning because should be ongoing all the time	Ruth, MC, KI
Need to focus on different aspects of Ma1 in planning	Mary, CC, KI
Coordinator needs to develop an overview of maths planning	Ruth, MC, KI
People realised they didn't know how to put Ma1 on planning	Ruth, MC, KI

Appendix 6.

Selection of extracts from initial interviews (coded and annotated)
(These extracts show initial coding and researcher's comments)

Linda	**18.11.93**	**Interview impression** **Interview summary** **Interview extract, pp. 1-9**
Liz (JC)	**24.11.93**	**Interview impression** **Interview summary** **Interview extract, pp. 1-5**
Headteacher	**28.2.94**	**Interview impression** **Interview summary** **Interview extract, pp. 1-2**
Olivia (WG2)	**5.10.94**	**Interview impression** **Interview summary** **Interview extract, pp. 1-4, 9-11**

Interview impression

Interview No: **2**
Interviewee: **Linda Year 1**
Date: **18.11.93**

Linda has a precise manner, and her approach to the interview was rather formal. Her comment at the end "Did I give the right answers?", indicated that she had been nervous about it. It was therefore rather difficult to get a 'flow', and rather a lot of my questions were designed to do this in preparation for being able to probe more deeply, or hoping that more relaxed conversation might reveal more of her attitudes.

I felt she was a teacher who had to keep a 'tight hold' on everything to preserve her own confidence. She obviously worries about noise in the classroom, and this may be one reason for liking the 'formal' work so much.

Her thoughtful responses to the questions on Ma1 led me to think that she was not allowing herself to reflect on children's learning, but felt she had to concentrate on 'putting them through the hoops' even though this does not seem to be the policy of the Infant department.

As soon as the tape was switched off she said:

"Of course AT1 is the real bugbear. It's so difficult to know if children really are showing that they can use and apply. Are they making the decisions for themselves, or are they just copying someone else? I asked if it was the assessment of Ma1 which was causing the difficulty, and she said she thought it was.

She presented the picture of a rather isolated teacher whose outward appearance was matter-of-fact and organised, so isolation was not perhaps recognised. Her clear enthusiasm and interest in the opportunity to team teach seemed to bear this out.

Interview summary

Interview No: 2
Interviewee: Linda Year 1
Date: 18.11.93

1. Briefly describe the teacher and any significant background information.
In her third year of teaching, now feeling more confident about mathematics. Has only taught at this school. Views about mathematics, or at any rate how she goes about it, not necessarily shared by other teachers.

2. What were the main issues or themes that struck you in this interview?
Rigid division between 'formal' and 'practical'. Focus throughout the interview on skills of recording (which were hard) as opposed to practical work (which was fun and easy). Practical seen as means to an end, and top group hardly doing any. Heavy emphasis on number activities, although didn't necessarily enjoy this more.

3. Summarise the information you got (or failed to get) on the key areas below.

Teacher early on in her career, initially anxious about mathematics and glad of the prescriptive nature of NC to tell her what to do. Seems to equate success in mathematics with being able to record it efficiently. Activities seen as either 'practical' or 'formal'. Personally enjoyed providing activities of a more cross-curricular nature, but described these as being more imaginative, rather than in mathematical terms. Made very little reference to ideas or concepts in the children's learning.

Dismissive of how a scheme had been used on her teaching practice, and interestingly couldn't remember any of the mathematics she'd done there. Now used a scheme with the more able children who could record their maths.

Using and Applying UAM as anything practical, or as part of everyday life in school. Situations where children worked things out for themselves, or used their hands. Ma1 was evidenced by number manipulation, and the ability to make choices about what they needed to carry out an activity, and to be able to transfer the success or failure of these choices to a new situation.

4. Anything else that struck you as salient, interesting, illuminating or important? Children seemed to be thought of as going through the hoops which led to nice neat recording of mathematics.

Linda Year 1 18.11.93 Sheet 1
(pp. 1-9)

A researcher L Linda

A I really just want to talk a little bit about the maths that you do in your classroom. what sort of maths you enjoy doing. Could you describe an activity perhaps that you've done recently that went really well.

L I'm sort of dividing my maths into two approaches, really. Some of it's very formal and some of it's practical and what I tend to do is give them all a formal part of the morning, when they're actually doing something written which will go into their maths books, and it will be following a Peak card or a sheet, or copied from the board - quite formal really, then I'll do like a fun afternoon when we play games, do number puzzles, colouring number cards, in which we just play with numbers. If I think about this morning, we were actually doing maths this morning, I liked the way they were all working in a really formal way, but all at a different level, and the children that I had a feeling were just counting one to ten, I actually gave them some very simple addition cards and I thought I don't know if this is going to work, and they'll need help and this may be a bit of a disaster, but I actually set them working in pairs so they had two working on the one card, and they were writing the question down together, and they all coped with it beautifully, I was really impressed. I was really amazed, I hadn't thought they'd got that skill.

A Had they come across the signs and things before?

L Oh yes, we do a lot of sort of writing it on the board and holding up the add and equals and getting them in the right place, and a lot of things like that, fun things, and they coped really well.

A So they would have done the practical sort of lead up to that?

L Oh Yes, I wasn't sure that they could actually do that, so that was nice.

A So they had to interpret it for themselves and write it down.

L And because these children haven't necessarily got advanced language skills as well, that were writing it down, I thought would have been a problem, but they coped really well.

A Is there quite a wide range in how many can record their maths in the class?

L Yes, there is. I have a group who are very bright and really are working very formally. I've got a group who are I would say a middle group who are doing a lot of practical and a lot of formal work and a group who really are still counting, learning very basic skills. And that's quite nice because it really does make you think about what you're doing, I suppose. ...and you can see the progression.

A And would they not be doing formal work because their writing skills aren't up to it?

L Um ... yes ... in some cases it's just getting them to write across the page and actually to set it out properly and that sort of skill, which they'd got, which I was really surprised at.

A Some of them are very young aren't they?

L That's right, some of them are only just 5, and of course some of them are 6 already.

A So which ... is there anything special in maths that you particularly enjoy, you know, would you say Oh good we're doing .....?

L ...that today. I like doing sequences because it's something that's cross-curricular, you can have a sequence of your day, you can write a little bit about it, you can do the clock work for it, and what comes next, and you can colour it ... . I like activities where they're doing lots and lots of different skills, that are quite imaginative. I like making up stories about things when you have to work out the answer to a story. EM

A Like a mathematical story?

L Yes something that's not just one subject, although I do teach like that sometimes, but it's nice to do that sort of imaginative thing as well. MP

A So at that point you would say that you were enjoying that more.

L Yes.

A So do you try to put more of that into your planning?

L Um, well no because we plan in subjects, you do tend to just look at that subject, but when you come to the lesson notes about how you're actually going to do this that then you make it a bit more imaginative, you probably put down the skill in your planning but when you actually come to do it you put more skills ...You're still doing Time but .... cross curricular? PM

A You're drawing on other subjects aren't you?

A And what about Attainment target 1 in maths? How do you see that sort of working with the other attainment targets?

L Well I mean you're doing lots of practical maths, all the time, you're doing it in PE, you're doing it in lining up and taking the register, and everything that you do which is ... they're working it out for themselves, they're using their hands, they're ... anything practical, is usually quite mathematical isn't it anyway? AT1 Mal as practical part of everyday life where they work out for themselves

A Mmm

L Or tends to be. That's why I do have sort of like practical afternoons, it's very much like a play situation, cos at least I know that I'm giving them the practical - I don't know if I'm doing it correctly but at least I'm giving them the practical time to work things out and play with numbers, which they do at other times as well, but it's a nice time for them to see it as fun.

A Do they see the other as 'not fun' do you think?

L Um I think they find it harder. My very bright group love it, they love doing formal things, for them it's not a problem, for them it's just competition, and they love doing that ... for the others who aren't so keyed up on maths, I think they find it harder, yes, and when something's harder, it's not so much fun is it?

A So what would you do then, do they go on longer with the ... practical?

L I'd give them short formal activities, with a little treat at the end, then they can do a puzzle or something of their own choice. It's hard to know how to make the formal activity more exciting in some ways. I'm sure there is a way of doing it, but ...

A I mean do you see them as very much separate things - the formal and the practical?

L I have been teaching it that way, I must admit. I know that I should, maybe ... yes, yes we do, some activities they do have to use the cubes for, and they do have to go and find things out, so in some activities, yes, but I do tend to teach practice and written.

A Is it likely to be more in Number that that happens, rather than in ... shape and space or ...

L Yes it's probably more number.

A Which part do you enjoy most of the different parts of maths - have you got a favourite?

L Yes, I think I enjoy recording work, because once they have an idea how a graph is set out, you can give them squared paper and they can actually go and find things out. I like sending them out to research things and find things out, and I like measures, that's good fun, and numeracy ....

A Cos there's often something that teachers find really difficult.

L Yes

A You know any part of it that you find particularly hard to understand yourself?

L Yes, um, sometimes it's - I understand concepts, but it's how to approach it so they understand it better, you know you don't want to talk above their heads. Sometimes it's how to approach a certain thing.

A Right, so it's not just your own subject knowledge, it's actually how to teach ...

L How to get it to them.

A And which parts do you think are difficult in that respect, from your point of view.

L I must admit I had a big problem about how to set out a sum when I first came into teaching, and it was just seeing other teachers, you know, hold up little cards, and, you know, doing it practically, things like that. Actually putting things down on paper is fine but getting them to then put that onto the computer I find quite hard, cos really you have to be with them, it's really class management, that. Missing number sums we were doing last week, and I did wonder if I was explaining that correctly, um, you know the fact that you count on and you count back or you've got the answer, you've got part of the question, you've got that bit to fill in, they find that very hard. I explained it a couple of different ways actually, I don't know if they'd just got used to doing the sums, or if I'd hit on the correct way of explaining it, but they did actually get that concept.

A I think it's because on every other occasion the answer comes at the end, so that's what they expect....

L And they've got the answer, so why are we asking them to do anything, they're geared into that way of thinking, aren't they?

A And what about the ones who go off and research things, are they good at using their initiative?

L Yes, and they've usually got all the other skills that they need as well, they're independent, they can be trusted to go off and do something, they can write it down, they've got recording skills, they can make an assessment of it, it's the most, it's the least, they've just got all the things necessary to do that activity. Some children you just know that the minute they come to a table they'll just stay there, they'll be talking, they'll be chatting, they won't actually go round and get any information.

A Do they work on their own, or do they work in sort of mixed ability groups for that sort of thing?

L I send them out pairs first of all, do you mean in general.

A When they're doing something like that?

L It would depend on the activity I think, sometimes groups, sometimes pairs, sometimes by themselves, you know, it would depend on what we were doing really.

A Um, what about your own, your own sort of thinking about maths, has it changed much since the National Curriculum, or over the time you've been teaching?

L I've only known the National Curriculum, I've only been teaching, well this is my third year now, so I do not know anything other than that. In a way it was good when I first came into teaching because it did tell you exactly what you had to teach, (couldn't hear next bit)

A Was your training, did you go through all the National Curriculum in your training, or were you just at the time when it hadn't quite come in enough for you to do that?

L No, we had all the documents and they'd had a year, I think, of working with them, so they were very much working to that.

A Where did you do that?

L I did that at [...].

A Was that just the one year, postgraduate?

L Mmm... too short, far too short.

A Did you do a teaching practice here/

L No, they sent me to schools in the [...] borough, [...] area. I must admit I can't remember, I can remember all the language work I did with children on that practice, but I can't remember the maths at all, which is very odd really. But at the two schools they were following a scheme where you literally worked through each page, so really I didn't do very much!

A Probably why you don't remember it!

L Didn't do anything practical at all.

A Really?

L D'you know I can't remember, I must have done, but I can't remember, it didn't stick in my mind.

A Did that actually affect your attitude to how much you use a scheme?

L Um, yes, it must have done. I'm happier using the cards we have now, but the first two years I really didn't use them very much at all, I wanted to do it myself. I'd use a sheet, or I'd invent an activity, or I'd use a sorting tray, or whatever, I sort of wanted to do my own thing. Now I'm happier to use the cards, and do my own thing as well. I can now see that the card is quite a purposeful thing to be doing, if you've

done the ground work beforehand. But I suppose it has put me off, I hadn't thought of that before. ASc

A Well I just wondered, because sometimes if you see the disadvantages of using the scheme and nothing else .... but you obviously started off wanting to find out for yourself.

L Yes, I didn't want, um, the first class that I had weren't very numerate so I had to do a lot of counting, the cards are no use for that unless you count the cards! There was lots of practical things anyway. I think they have to get to a certain level to even work from a card. ASc You know if you've got children who just aren't at that level you can't use them, that's one of the disadvantages. Not that I want to say PM anything about the scheme here! Felt shouldn't be critical of scheme?

A Oh no, well it doesn't matter, you could do! Because people all use it in varying amounts don't they. You don't all use it the same amount, do you?

L No, that's right, it's good in that way that we're not expected to ASc have reached .. 3.5 ..by the end of this year, we can do what we want to do. So that's good.

A And presumably when you've got this progression (school progression) worked out, then you'll be working from that as well, and have that as an added resource, really.

L Yes, mmm.

A When you're doing maths do you choose to do maths with the whole class or do you usually have an 'integrated day' type day?

L It depends ... I tend, it's really funny, they tend to start the week all doing different things, different subjects, I've got lots of energy, OM they've got lots of energy, we really can get into it! By Thursday, and Friday!

A You're doing all single subjects are you? Oh right!

L Yes, it's really funny, yes, that's right

A That's how it goes, is it?

L I think it does, actually, I think it does a little bit, looking at what I planned today, and looking at what I would have planned on a Monday, Tuesday or a Wednesday, it's quite different.

A So those, the activities where you feel you're more energetic would be more cross-curricular? This question was inaccurate, owed very a subject content activities

L Oh yes, they'd all be doing - I'd probably have someone working on the art table, someone doing a science activity, writing news, or about their pets, or something, then I'd probably have some maths activities OM

going on as well. And of course then they can change tables, when someone's done one piece of work, I can change them to the art activity ... and I know they've all covered certain skills in the day, hopefully in the day, or two days. OM Emphasis on skills

A Say, for example on a Thursday of Friday, would you perhaps have set them all going with some maths?

L Yes, all at different levels, all doing different sorts of things. PD It's more my mind, sort of just being able to concentrate on the one thing properly, perhaps, I don't know. OM

A No, it's interesting, but you obviously feel that one sort of work is more demanding, then.

L Yes, yes, I think you've got to be switched on to so many different things, mmm.

A Would you like to be doing that all the time?

L Yes, I would. Yes, I'd love to have energy all the time. But also their energy is waning as well, I notice very much by the end of the week. I mean they are quite little really, it's the first term. They seems to want to concentrate on things that are more practical, they don't want to hop around so much, their concentration is smaller, for what they can cope with as well. Perhaps I'll work differently in the next term. CP RR Ethos of class that these things are easier?

A Well you do change ..

L You do adapt. I must admit, you do get your class and then you adapt.

A And it depends on the class as well, doesn't it?

L Mmm

A Because classes have different characters, don't they? Some classes work much better in small groups, some classes work better ... in different ways. You've got a nice big room, haven't you?

L Yes, it's really good. We've got 31 now, so that's been wonderful, it's just right.

A And how do you organise the room, I actually can't remember - do you have different areas in the room, where they get different resources? How do you do that?

L Yes, I have an art corner, sort of near to my cupboard, I have the computer on part of the carpet, which is the quiet area, I have a couple of display tables and then I have a resource area for language, and I have like games resource area, then I have a maths resource area over in the corner, at the moment we're doing lots of money so it's got of coins on it, OM

and shopping cards, and things you can buy. I use the tables in two ways. They all have a table which is, they know it's their table, and when we do a class activity they have their own place at their own table, but then I also use the tables just as a circus, so sometimes it's just go over there, if they're doing an art activity, so I use them in two ways. I use the carpet and the quiet area as much as possible, and of course we've got the outside area as well. (corridor area)

A You can send them out there quite happily?

L Mmm, yes, so long as they're not too large groups, and obviously watch which characters you put together.

Interview impression

Interview No: **4**
Interviewee: **Liz Year 6, Junior co-ordinator**
Date: **24.11.93**

Liz seemed quite nervous before the interview, but relaxed quite quickly once we started. She said she had been wondering what she was going to say on her way to school.

Liz appears to carry quite a bit of authority in the school. She is a member of the Management Team, as Junior Co-ordinator, although she is by no means the most senior member of the Junior staff. She takes her responsibility for science seriously, and appears to be consulted quite often.

After the interview she apologised for 'rambling' and said "You know the really useful thing about talking like this is that it makes you think about what you're doing".

This interview was probably the most relaxed so far, because, although she kept saying that she 'should' be doing more, she appeared confident enough to take these omissions without undue anxiety, and the result was a very reflective interview which didn't cover a great deal of ground in terms of breadth, but meant that I was able to probe in greater depth.

Interview No: 4
Interviewee: Liz, Year 6, Junior Co-ordinator
Date: 24.11.93

1. Briefly describe the teacher and any significant background information.
Liz holds one of the senior positions in the school as Junior co-ordinator, and is obviously well regarded by the Head and by other members of staff. She has a quiet air of authority, although she is younger than many of the other members of staff. She has been teaching for about 6 years. She holds responsibility for science in the school.

2. What were the main issues or themes that struck you in this interview?
Her ability to be fairly reflective about her own practice in interview, indicated a certain degree of confidence. She was very articulate, and able to describe her thoughts and feelings well. The difference in attitude to Science 1 as opposed to Ma1 was interesting.

3. Summarise the information you got (or failed to get) on the key areas below.

She uses Peak a lot, probably for more than 50% of her maths (and is somewhat apologetic for this), but obviously enjoys class teaching of new ideas as well. For the work outside Peak, she prepares work for three attainment groups, often taken from other schemes. She is enjoying having a class with whom she can have a more relaxed relationship than in previous classes, and considers that the lack (in her terms) of open-ended work is because she doesn't give them the opportunity, rather than because they can't do it.

Using and Applying
She described several aspects of Ma1, while saying that she didn't really do it. She could talk about children choosing methods and equipment, communicating their mathematics, and going off in different directions, but she felt that she did not initiate enough of this, especially for lower attaining children.

4. Anything else that struck you as salient, interesting, illuminating or important?

She seemed to be on the verge of being able to tackle Ma1 to her own satisfaction, and needed some input, rather as she had had in science.

Liz, Year 6 and Junior Co-ordinator 24.11.93 Sheet 1
(pp. 1-5)

A I think a good way to start is by asking you to talk about some maths that you've really enjoyed, in the classroom, let's say this term.

L Oh, that's tricky! Maths that I've enjoyed ....

A Or that you think the children have enjoyed ... might not be the same!

L No, probably not the same! Although the children, actually, the kind of maths they enjoy the best, I mean, I've done investigations with them, but what they really like the best is just to work through their Peak books. That's their favourite kind of maths. I mean, obviously it depends on the page, but, um ... They enjoy doing that, I enjoy teaching them new things that they don't know, as a class, because it's nice to sort of dazzle them with something they haven't come across before. Um, and I quite enjoy doing investigational kinds of maths - Gnorman Gnome was good fun.

A Yes, how did that go?

L It was all right, we didn't take it as far as we could have done, I mean I could have gone - you can just take that further and further and make it more difficult for them, but we sort of ran out of time and other things came along. But that was a fun starting point because within the first sort of lesson you've got so many different kinds of maths, you know you've got them actually making the shapes, then trying to change them into two dimensional drawings, and then looking at the isometric paper and taking their drawing a bit further, and then start talking about things ... (couldn't hear this bit) new concepts, they've got all of that. It's all quite simple so they can actually follow it themselves quite easily - not a very taxing exercise, but ... They enjoyed that because there were lots of different aspects to the one lesson, which was quite good. Why I think they like the Peak books, because, you know, if they work really hard they can do a couple of pages and they might be doing adding sums on one page, then all of a sudden they're do a graph, and they really like that.

A Right, so, because it changes frequently doesn't it?

L Yes.

A I mean, some schemes are now organised in terms of maths topics, aren't they, but Peak isn't like that is it?

L No, I mean Peak, the danger of Peak is that unless you go through it yourself and reinforce it with other exercises, you just skim over things. I mean that's the problem with Peak.

A And what happens about learning something new?

L Learning something new, we either do as a class, or we do it in our maths groups, because they're all on different Peak levels, so we'll either ... if I'm doing it with little groups then they all come and sit on the carpet and we go through the exercise that Peak's in, and I give them any information that they need to help them do that exercise. Otherwise, if I was introducing something like prime numbers or multiples or something like that, I'll do it as a whole class, and just have 15 minutes standing at the front, talking to them about it, and then differentiate in their activities that follow that, so I know a lot of the time when I'm standing at the board I've, after the first five minutes, I might lost some of them, but I think it's quite good for all of them to listen to the same information now and again, because hopefully they'll pick a bit up, and then they'll remember it next time they come across it. And also, you know, I don't know, I think it's good for some of the ones that you think aren't ready for that kind of stage, and you find that they surprise you in something they can do. I quite like doing that, I think. But I don't really have any ... my maths this term is different from last year, I'm trying to do it differently, and they are in their Peak groups, but they're working in a much more individual way within their Peak groups, so although I pull them together from time to time to make sure that, you know, I've explained a certain exercise, they don't necessarily start the same exercise on the same day.

A Right, just working through at their own speed.

L Yes, whereas when I did it before, I would introduce a lesson per group every time, and then I found that some of them did the work and were ready for something else, and some of them didn't, and just for ease of organisation this term, I've let them work through the pages that I set them, but at their own pace, and they do actually tend to stick more or less together.

A But they don't just go on beyond what you've set?

L No, no they have to, I mean, I set, I might go through a couple of pages at a time and explain them, and they have to come up to me every time they've finished a certain section, they have to come up and get it marked and explained. But there's not as much control as when I've done it before. I'm really aware that a lot of the time I'm letting them find things out for themselves, because I obviously don't teach every single principle they're coming across, but they don't seem to find that a problem, but I might find that next term when I revert back and do it differently, that they haven't understood, what they're doing. But at the moment, I just wanted them to do it like this for this term, because it gives me a better idea of who's where and who's capable of working independently and who's not, and after the first term, I don't think it's a bad thing for them to whizz through a book, and I put them I am sure at a slightly lower level than they're perhaps able to do, so they've all achieved quite a lot in terms of, like they feel they've finished a book, so they're on to the next one, but next term I shall have to go back, I think, to my other way of working, because I don't feel, this way, I'm really, really in charge of their learning.

A Do you miss some of it out for some children?

L Yes, for some. There are certain bits for all because what I try to do, and some weeks I've been really good at doing this, and sometimes I haven't, is to take maths themes as well, so perhaps have two sessions of them doing Peak, and two sessions where there's a theme, so I start it as a class lesson, and then I take work from the Ginn books to back that up. Say, for example, I taught them all using the decimal point, or I taught them all sort of some kind of number, that's my 'teaching' teaching for this term.

A And do you enjoy that part of it

L Yes, I mean I like doing the maths, I find, this, this is a lazy way of doing it, to have two class lessons almost, where I have to think very carefully about the work that I'm going to set them as a result of my standing at the front of the class, but the other two sessions are very easy because they just get on with their work and I pull them up periodically during the lesson, but they're all working all the time, which is good, and it means that I can get round and I can mark things and I can sort of look at them individually which is good, but it feels a bit lazy doing it like that. Whereas before you know you felt you had more control. I don't know, I really experiment with maths. The last school I was at we used to set for maths, so this was very different again.

A In Year 6. Have you been in Year 6 for a long time?

L No, I was Year 6 last year, and then when I first came here I was Year 4, and before that I've been Year 3 in my last school, and that was always setting.

A It was set in Year 3?

L Umm, throughout the school, I didn't really like it much.

A Infants as well?

L No, it was just a Junior school. It really broke, it really dictated your day because you knew at a certain time you were going to lose half your kids and get somebody else's, and also you set, but within the set there's a huge range anyway.

A Two sets?

L Four, four a year. I don't know, I haven't really got an ideal system sussed for my maths yet.

A What about the attainment target 1 sort of input. You've been talking about the investigations ....

L That probably doesn't get covered very often, I haven't this term. Unless I really start an investigation with them and I've only done um Gnorman Gnome, pattern work, some shape stuff, I haven't done that much.

A Can you see the advantages of it?

L Oh yes, yes, but there's just so much planning. I mean, Peak have supposedly got investigations in there, but I don't think you can really count those because they tell you what you've got to do... But it involves such a lot of thought, doesn't it, um, so I'm not very good at that. I don't mind if I've got an investigation up my sleeve, like a good old favourite to start them off with, but I don't do them as often as I should. And certainly not to the extent where they're choosing their own equipment, I don't do that. They've always been quite structured investigations.

A Right, yes, I mean, do you think, is that something, you keep saying 'should', is that something you think you should be doing?

L Oh only because every time I look through the maths attainment I keep thinking 'you're not addressing AT1', um, I don't feel so guilty about it because there are other things that have priority. My priority for them this term really as far as maths is, is to revise, to go over things that I know they've covered and just get their understanding of the concepts a bit better sort of sorted for some of them. Some of them are taking forever, but .....no I think I should be doing it. I'll have to, to tick the boxes!

A How do see AT1 in maths in comparison with the Science 1?

L You see I love doing the AT1 Science.

A Why, is that because you're more confident in science?

L I don't know. Well, science is my area so I have to sort of do that one, but I find that quite easy to organise because you pose them with a question, then they have to sort out how they're going to find the answer to that question, or at least explore that question, so they come up with all the ideas themselves, and as long as they're on the right track, they're a legitimate investigation for them, and they say what they need and everything. Whereas in maths, you can't really ... well I've never tried ... I didn't know what kind of open-ended question to start them off with, and then I don't know, I just find that a lot more difficult to say, right, we're going to find out ... I don't know you'd even ask them to find out that they had to think about, what they needed to find out the answers.

A So is that to do with you knowing more about the subject?

L Well no, probably not perhaps the subject, because I'm confident about the subject, but I've had more experience of how to introduce ATI in Science, from courses and having to read up on things, whereas, 'cos maths isn't my area, and because maths trundles along quite nicely, I've never sort of been faced with, like well you'd better sort it out.

Interview impression

Interview No: **19**
Interviewee: **Headteacher, Laura**
Date: **28.2.94**

Laura is always very happy to talk to me, and seems to find our talks interesting. She is always on time for an appointment, and appears unhurried, but businesslike.

She always maintains a strictly professional approach, and only mentions staff by name if she is being complimentary. She is aware that her arrival three years ago and changes since then have not pleased all members of staff, but seems confident in the benefit of her reforms, and keen to see the school develop further.

She is determined to keep in contact with the classes by having a regular teaching commitment, although keeping to this is often difficult because of the frequent meetings which Heads and Deputies now have to attend. She obviously enjoys her management role and feels successful in it.

Interview summary

Interview: 19
Interviewee: Headteacher
Date: 28.2.94

1. Briefly describe the teacher and any significant background information.
Head has been at school for 3 and a half years, and has made many changes, particularly in the management structure. She is very appreciative and supportive of her staff, and manages to provide them with a considerable amount of non-contact time and out of school INSET. She is on informal terms with all the staff, and frequently visits the staffroom and talks happily to members of staff there. She is understanding of behaviour difficulties, and intervenes if she thinks the teacher needs a break.

2. What were the main issues or themes that struck you in this interview?
Confidence in management reforms, vision for the future, understanding of teachers' difficulties.

3. Summarise the information you got (or failed to get) on the key areas below.
Very supportive of maths development. Believes that teachers need to work alongside others in order to change practice (has team-teaching background herself). Believes that teachers lack confidence in maths teaching, but are probably more competent than they would admit.

Using and Applying

Feels that she rather restricted the approach to Ma1 last year by her use of the wording practical/investigative maths. Is glad that the INSET day broadened this out to the whole of using and applying mathematics.

4. Anything else that struck you as salient, interesting, illuminating or important?
Purpose. Firm belief in the importance of getting the management right. Support for staff. Was aware that teachers need to talk about their difficulties and felt that talking to me gave them this opportunity. Did not suggest, and nor has anyone else, that the school could provide a forum for discussion.

Headteacher , Laura **28.2.94** **Sheet 1**
(pp. 1-2)

Some of this interview was taken up by requesting factual information about the management of the school and its position within the LEA. Only those parts of the interview directly relevant to the maths development of the school have been transcribed.

Due to some faults in the tape, which kept jumping, there are gaps which are indicated by dots. On other occasions I have tried to fill in the gaps from my notes of the interview.

A Can I ask you now a bit about the maths development ?

H Yes

A ...and, um, you know, your feelings about how you think it's going, you know, the sorts of things that have happened during the course of the year.

H I'm happy that there is, I feel that there is beginning to be development in maths in the school. I think I'm beginning to be more conscious of what I think is happening and what is actually going on in reality behind closed doors, um, and that is a worry to me and that is something I know I've got to address. Now I see, on our next development plan we've actually got the role of the co-ordinator highlighted and that's where I see them, ... I mean with all the best will in the world I can't get into the classes that often and I can't cover every aspect of the curriculum, but I would see the curriculum co-ordinators making a start...

A And you think that will help ...

H I think it will do. We've noticed a difference this year, in that three or four members of staff, Ruth is just slightly different to the extent that she's in the Nursery ... but I think it would be far more effective if she was able to see for herself.

A And also for her to make contact with the junior ...

H I was lucky in that she's had that experience right through anyway, but a lot of them haven't, certainly the Key Stage 2 people have got no sort of involvement with ... the Infants.

A And what was your reaction to the change, well slight change of approach for the next year's development plan?

H Oh I think that's great, because I think that's really ... I've said to you in the past, I feel I've been at fault in that giving that pro-forma out to people to look at staff development, I had just practical and investigative maths, and I think that in itself was restricting...

A Do you think it's important that people should be able to say openly that they're still having difficulties?

H Very much so, yes. I mean, one likes to think that that's the environment one's created, in that, yes, in that I hope they realise that [...] they've always got the chance to change things.

A And what do you feel is needed to encourage teachers to change practice?

H I personally think it's by being shown by example.

A Mmm

H I think if they can actually get themselves into other people's classrooms and see [...] I think this is because of my experience, I mean, my first teaching post of two and bit years, and then my second teaching post of four years was in a team teaching situation...

A And this is what the teachers were asking for?

H So basically, what do we do, and how do we do it,

A Can we see somebody doing it?

H Yes

A Yes, so hence the commitment to having the adviser in to work in the classrooms?

H Again, you've always got to be careful as well, because I know they were the same with science, really when I first came, all they wanted was the science advisory teacher to come in and show them how to do it. I think it's got to be very much working alongside ... which is why we've asked Eva Farley to come in in June.

Interview impression

Interview No: **20**
Interviewee: **Olivia, Year 2**
Date: **5.10.94**

Olivia is in her second year of teaching, and has moved to the school from [...], having spent last year teaching a Year 5 class, even though her training was for Infants.

She spent a year abroad between school and college, and then completed a four year BEd course of which maths was the main subject.

She is a member of ATM, and attends weekend workshops frequently.

Olivia has a confident, open manner with other members of staff, both informally and in the small group meetings which I have so far observed. She has indicated an unease with the lack of clarification on UAM during the working party meeting, and feels that she works in a different way from the other Year 2 teacher.

She encourages her class to think of themselves as mathematicians, and presents a image of mathematicians that involves enquiry, challenge, enjoyment, discussion, trying again, being systematic. She is aware that many children take on a fear of mathematics from their teachers, and is anxious to create quite a different feeling about maths.

She is aware of her position in the school, as a new and inexperienced teacher and not the maths co-ordinator, but hopes that she will be able to contribute to the maths development in the school through co-operation with the new maths co-ordinator, Nell.

Interview summary

Interview No: 20
Interviewee: Olivia, Year 2
Date: 5.10.94

1. Briefly describe the teacher and any significant background information.

Teacher in her second year, having moved from rural school, teaching Year 5 Mathematics was main subject at college, and she feels confident in this area, and tries to work in a way which involves the aims and strategies of UAM

2. What were the main issues or themes that struck you in this interview?
Confidence in own approach. Has convinced herself within her first year of teaching that her approach is right. Realisation that she must accommodate to needs of her class who are not used to working in this way. Realises that AT1 is a very difficult area for most teachers.

3. Summarise the information you got (or failed to get) on the key areas below.

Works with a variety of resources, mainly ATM materials where possible. Does not rate Peak scheme highly.

Using and Applying
Encourages children to discuss and record their own mathematics, to not mind being wrong, to try again, to be systematic, to have confidence.

Differentiates by task and by outcome. Uses discussion to assess and challenge children.

Worries about accountability, when much of work is discussion, and not filling in pages in books.

4. Anything else that struck you as salient, interesting, illuminating or important?

The air of confidence. Acknowledgement of difficulties, but sure about where she wants to go in mathematics.

A Could we start perhaps, if you could describe some maths that you've done in your classroom recently?

O We started looking at odd and even numbers and I told my class - whenever we do any maths I tell them that we're, I remind them that they're mathematicians, and we talk about what mathematicians are. And at first they just said it was people who were good at maths. I said it in a very deliberate way - **math**ematicians - what do you think that's about? Um, whereas as now they're tending, not all of them, but they're tending to think about the fact that mathematicians like to look at maths and they like to think about maths, and try and sort things out. They don't always get it right, but they're good at trying again, when they don't get it right. Because I found that when I was marking the work they weren't even looking at things they'd got wrong. They weren't trying again. And so to get them into this idea that you do try again and that's actually quite exciting, that you can try again. So we talked about being mathematicians and then talked about how mathematicians like to sort things out a lot. They like thinking of different ways to sort things out, they find that interesting...

A Mmmm

O And I said well let's think about what we know about sorting things out, and we sorted out the class, and I made it very practical, they were suggesting things, ways that they could sort things, and then I'd say "OK all of those people go over there." and so that they were realising, and we talked at the end about having realised that we could actually sort our class in a lot of different ways. Um, and then I said, "well mathematicians have a particular way of sorting things out, or one of the ways they like to sort things out is by doing odds and evens. Does anybody know what they think about those." So they thought about that for a while and one child said " evens mean always having a partner" and I didn't necessarily want them to stick with that idea because I think it's very confusing, um, so we kind of discussed that a little bit and I had that child - I didn't discard it - I said "well what do you mean, let's try it." So everybody in the class got a partner, and everybody had a partner, and I said "Does everybody in this room have a partner?" and of course I didn't, so they said "No, you don't." And I made this big thing about how I must be **odd,** and I'm **odd**, and we went on like this ...

A Yes

O ...and they said "because you're left out", and I said "It's more that, that if something's left out then it means that we can't split it perfectly. So then we went round the room, I mean this discussion went on for about half an hour, finding things - I'd just pick up a pile of books, and do estimation "How many have we got here? OK." Then we counted them and we said "do we think it's going to be odd, do we think it's going to be even? And just familiarising ourselves. I was careful to make sure that quite a few of the numbers were under 10 at first because I do have some children who are poor with number, but they're good up to 10 and I didn't want to confuse them, but I wanted it to be accessible to them all, and the language. So we went on and on like this and then eventually they were to sit down and work through, it was a tombola

sheet, and they won everything that had an odd number, so they had to decide which ones had odd numbers. So that was actually a consolidation, so that I could see who really did understand what we did. And they had to work systematically, and think of a way to show that they'd checked.

A How did they?

O How did?

A Yes, what ways did they use?

O Some people just coloured in what they had found, some people put a cross on the odds. They were unwilling to do it without being told "what should we do?" They wanted to be told what they should be doing, and I said "You must decide" ... 'Cos I think that's part of getting them in to it, is to be making decisions for themselves. And we've been carrying on work with that. That was one thing that was quite exciting!

A And is that a sort of typical way that you would work?

O Yes

A Using those sort of ...

O ... tactics of getting them to discuss it and think about it, and also it's a nice way because everybody, because it's lively, it's a nice way of introducing something that could be quite scary for some of them, and it's a good way for me to listen to all of them, cos I try and choose different children every time, to see what language they're using, because I think quite often what's happening is that they use a word that's different, or they understand a word in a way that they've basically misunderstood what's going on, or they may use language, and if I'm not listening carefully enough I'll say, "No that's not right." And in fact it is, they're just saying it in a bit of a jumbled way. So again, to get them to clarify and to get a common language going through ... so that they feel secure before they have to sit down and be by themselves for a bit. I do try and work like that. I mean, whilst I've been settling the class, I suddenly realised that I hadn't been. I couldn't work out why it was so laborious, but I realised I wasn't teaching in the way I wanted to because they weren't quite ready, as they were settling in.

A So, I mean, you've been teaching last year, that was your first year of teaching. Was that, was that somewhere elsewhere in the country?

O It was in [...]

A And did you, I mean, did you start off with those ideas, particularly about maths, that this was the way you wanted to approach the maths?

O Yes

A And where did that come from?

O Um, I guess it came from college. I guess it was the way - at college I had a tutor who would start lessons like that, and make us all do that, and I was very aware of the fact that I was a maths specialist and I was in an education group that had a lot of mature students who were afraid of maths, terrified of maths, and that always used to worry me. I thought, if you're so frightened how are you going to be able to teach children and not communicate that? So she would, we would have like modules going with particular people, and it just struck me how she was able to motivate these particular women who, in other maths classes we would have, couldn't, you know, would be really quiet, and panicked, and saying "No I want to use SPMG, I feel it's good." And they couldn't see any other way, but when she was giving them these tutorials, they actually saw that there perhaps was a different way of doing things. OK they could consolidate what they'd done if they still wanted that safety net, but really introducing concepts, it was not a good idea to do it through a book like that.

A Mmm

O So I guess I just used the same strategy with my class.

A Were you able to on teaching practice?

O I had an unusual teaching practice in that the, my final teaching practice, the reason why I did my dissertation on Using and Applying Maths, was, I guess it wasn't unusual, they wanted me to use SPMG, and didn't want me to do any other sorts of maths.

A Right, this was on your final teaching practice?

O Yes, so I then had this struggle and this conflict of "I'm not teaching the way I want to be teaching.". So I then requested, maybe I could do my research within the classroom, for two reasons, one of them was so that I could show the teacher perhaps another way of doing it, and also to see whether or not I really could do it.

A So, I mean, really, you started off ... Is it right to say that really Attainment Target 1 is the centre of your mathematics teaching? That you're teaching your mathematics through that?

O Um, I'd like to say that that was true, but I don't think it is, not yet.

A Right. Can you tell me how you think it fits in with the rest of mathematics?

O I think I develop an attitude for them, through the way I introduce maths, and I think that that is influenced by the requirements of Attainment Target 1, that's what made me consider it, but I also feel very limited by my experience of teaching areas of maths, so as I become - like I'd never taught odds and evens or considered it with children before - and again, last year when I was teaching fractions, and talking about

fractions, I'd never had to think about teaching children fractions before, because in your teaching practices you don't teach these things.

A Mmm

O So it's very much, as I find good ways, I will repeat them, but it's a case of getting to the stage when I have that resource bank within my own knowledge... it's getting there. Need to build up own resources

[...]

A Right, right. Um, it's sometimes thought of as a common belief, not necessarily here, that there are certain things that have to be taught first, before using and applying mathematics, Ma1, AT1, sort of comes along.

O Mmm.

A I wonder what your views are about that?

O I don't think that's true. I mean, children in the Nursery are using and applying if you ask them to sort things out, they're using and applying, they ... again, it's depending on whether or not, you know, what ... I think, yes, schools would feel that, if they think they're doing using and applying any time they do maths, they will think that then. But if they're looking at maths in a way that is actually exploration, and you're not perhaps writing down symbols and showing it in that way, then using and applying can happen at any time. In fact they are using and applying before they've got those other skills, and they can only get those skills through using and applying, I think.

A Right, so you would put your self firmly in that, with those who believe that.

O I do have a problem though, with, and it is a real, I was talking about it with one of the maths people this weekend, is that there is such a push in education now for evidence, and to be accountable, and I think using and applying will suffer as a result of that. My children the other day, we spent a whole morning talking about, looking at number, and playing a game, and I heard children say "We haven't done any work today!" and actually getting them to realise that they're thinking, and they need that familiarisation, they need to go over it and feel comfortable enough to talk about it, and I do then suddenly panic, and think, well thank goodness I've got a lesson plan and I can write an evaluation underneath, because they've got nothing on paper. And then when you do want them to write something down, if they're used to filling in sheets, they don't know how to organise it, they're poor at written work, but their mathematical thinking is good, but they can't actually communicate it. So you've got all of these barriers, that make it very difficult, I feel. I think I would do a lot more active work if I didn't have to be able to show ...

A Yes. How are we doing? Are you all right for a few minutes?

O Yes, yes.

A You've talked about quite a lot, without sort of specifying, about what you think children should be doing in the classroom that are part of Ma1, Attainment Target 1. Could you describe a little bit more. Perhaps if you think of two children who are at different levels in Attainment Target 1, um, you know, can you think of two children in the class you have now, and what sort of things would they be doing?

O I've got one child in my class who falls very firmly into the category of having excellent understanding of number, and can't communicate that on paper, but, I don't know if you saw that display in the classroom, the answer is 10. And he shocked me because he can recognise number patterns like that, he can actually - for example one of the children said 16 take away 6 is 10. And I could see him, and he was sitting there thinking, and then he said, "Well that means that 17 take away 7 is 10, and 18 take away 8 is 10". Now that is actually quite a mature thing for a six year old to be recognising, and I think what I'm going to be trying to with him, very much so, is to encourage him to look for pattern, but encourage him to actually find a systematic way of organising his thoughts, so that then when he gets information like that he can work with it, and I can push him on in that way, and kind of promote his learning in that way. Um, and that will all be complemented by doing things like odds and evens, because he'll apply them. He'll come up to me, he just walks by me and says "22's an even number!" you know, it's just this game with him ... AM1 BM AM1

A Sheer pleasure ...

O Um, on the other hand there's this child in my class, who can't count. He has very very special needs anyway throughout the curriculum and the work that's I've been organising with him, is the familiarisation of objects and recognising the symbols, but I'm not overly worried about that, because it's meaningless to him. So we do a lot of counting games, he's playing games with the support teacher that I have with him, counting and actually moving along, because he actually likes the idea of the game, that's good motivation for him, and I'll very often whenever he's finished something, I just say, "go and find me however many of something", and he can just about, but it is a bit of a guess, I feel, up to three. But organising objects, one object in that circle, two objects in that circle, so his using and applying would be happening when he's using the construction, making a tall building, but for the number it's very limited. AM1

A And you're obviously encouraging things like their own recording, from what you've said already?

O I was at first, and then I chickened out! Cos there was nothing in their books!

A You mean they weren't recording?

O They just didn't know how to. They would do scribbles, so I've got more in their books and now I'm getting them to think about how AM1

they might do it. I mean, throughout the curriculum, not just maths, with this class, they have no idea how to record. So I thought it was probably best to back off, and tackle other things first. So in all honesty, no, but that is something I do like to do.

A When you, you know, when you were coming to the school, were you sort of introduced to the idea that this area of maths had been, was part of the school development plan?

O No, I wasn't actually. It wasn't brought to my attention. Um, the first time I realised was when I was told that I was on the working party.

A Right

O And it had been recognised, because I then said to the Head "Oh that's brilliant, I'm really excited about that because I've done work in those areas". And she, I had said that in my application, and she said that was one of the reasons why I was of interest. So that was nice.

A Do you feel that you're going to be able to contribute?

O Yes, but as I mentioned to you last time we spoke, I feel it's such a very difficult area. People, especially because I haven't got the experience under my belt, it's very difficult for me to come in and say "well actually I think you should be doing maths like this". But having said that, talking to Nell, the maths co-ordinator, she thinks about maths in a very similar way, there's a safety in numbers, and in that way, yes I can contribute, because, standing alone it would be difficult. I'd want to and I would find a way, but it would be really difficult especially as I'm not maths co-ordinator. So my role is low profile in that respect, and I have to respect Nell's role.

A Yes. Well it's good you've been able to talk to her already about things.

O Well very, just talking in the way that, comments, and she had actually said the Blueprints is very good, have a look at it, and she's expressed an interest in joining the maths association working party, and also just from the meetings when she's said "Oh yes, I've used those", or "I know about those", and she's obviously worked with the same sorts of equipment as I have, and her attitude towards the teaching is the same, or similar ...

A Right, yes, thank you very much.

Appendix 7a.

Stranding analysis - 1

Name of teacher	Applications	Communication	Reasoning, logic and proof
Ruth N, MC, KI	Choosing and finding apparatus		
Madeleine R, KI	Choosing and finding apparatus Making decisions about what's suitable/available Organising themselves	Explaining what they are doing Talking about what they are doing	Ability to be logical Ability to reason
Diana R	Choosing criteria eg for sorting		Ability to be logical Ability to reason
Tania Yr 1, WG2	Maths in the environment Using maths in practical activities eg cooking		
Linda Yr 1	Maths in PE In ordinary, every day experiences, eg register Choosing and finding apparatus		
Lesley Yr 2		Asking questions	
Tessa Yr 2, IC			

Table 7.1 Stranding analysis - 1

Appendix 7a (contd.)

Name of teacher	Applications	Communication	Reasoning, logic and proof
Karen Yr 3	Applying what they know to new situations Working their way round a hurdle Developing and using strategies	Talking about what they are doing	Ability to reason
Olwen Yr 3 jobshare	Solving problems Making decisions about what's suitable/available		
Carol Yr 3, WG2 jobshare	Applying maths in technology, construction		
Mary Yr 4, CC, KI	Applying maths in technology, construction Finding a sequence of questioning	Explaining what they are doing Asking questions	
Valerie Yr 4			
Ursula Yr 5	Finding things out by themselves	Talking about what they are doing	
Mike Yr 5			Trying to discover things
Liz Yr 6, JC	Choosing and finding apparatus		Making up sequences, changing numbers round using their own series of moves Testing their theories
Meg Yr 6, WG1/2	Solving real life problems by applying knowledge Sorting information and working things out to make sense		
Eric Deputy Head, KI	Solving real life problems by applying knowledge Using skills to apply and fathom things out Looking for patterns Looking and analysing	Talking about what they are doing Recording ways of working	Coming up with their own theories

Table 7.1 (contd.) Stranding analysis - 1

Appendix 7b.

Stranding analysis - 2

Teachers' comments - initial interviews
Teachers' additional comments - final interviews

Name of teacher	Applications	Communication	Reasoning, logic and proof
Ruth N, KI maths co-ordinator until October '94	Choosing and finding apparatus		
Madeleine R, KI	Choosing and finding apparatus Making decisions about what's suitable/available Organising themselves ***Making informed choices***	Explaining what they are doing Talking about what they are doing	Ability to be logical Ability to reason
Diana R	Choosing criteria eg for sorting ***Finding their own ways of doing things***		Ability to be logical Ability to reason
Tania Yr 1, WG2	Maths in the environment Using maths in practical activities eg cooking ***Involving maths in other activities*** ***Being systematic***	***Recording findings systematically in their own way***	
Linda Yr 1	Maths in PE In ordinary, every day experiences, eg register Choosing and finding apparatus		
Lesley Yr 2		Asking questions	
Tessa Yr 2/1, IC	***Ability to use mathematical knowledge***	***Presenting alternative solutions*** ***Developing their own ways of recording***	***Learning to think mathematically***

Table 7.2 Stranding analysis - 2

Appendix 7b (contd.)

Name of teacher	Applications	Communication	Reasoning, logic and proof
Karen Yr 3	Applying what they know to new situations Working their way round a hurdle Developing and using strategies ***Deciding on the mathematics for themselves*** ***Being open to a variety of methods***	Talking about what they are doing ***Writing and talking both important*** ***Using mathematical language***	Ability to reason ***Predicting and estimating***
Olwen Yr 3	Solving problems Making decisions about what's suitable/available ***Planning their work*** ***Getting resources and setting themselves going on a task***		***Working logically***
Carol Yr 3, WG2	Applying maths in technology, construction ***Using maths to solve problems***		
Mary Yr 4/6, CC, KI	Applying maths in technology, construction Finding a sequence of questioning ***Using alternative approaches*** ***Planning their work***	Explaining what they are doing Asking questions ***Explaining their methods to other children*** ***Writing down their own thought processes*** ***Expressing themselves in numbers and diagrams***	***Developing logical ways of questioning***
Valerie Yr 4	***Focusing on methods used*** ***Planning their work***	***Writing down each stage of the problem***	
Ursula Yr 5	Finding things out by themselves	Talking about what they are doing	
Mike Yr 5			Trying to discover things ***Making predictions and justifying their solutions***

Table 7.2 (contd.) Stranding analysis - 2

Appendix 7b (contd.)

Name of teacher	Applications	Communication	Reasoning, logic and proof
Liz Yr 6/4, JC	Choosing and finding apparatus ***Checking results***	***Working collaboratively***	Making up sequences, changing numbers round using their own series of moves Testing their theories
Meg Yr 6, WG1/2	Solving real life problems by applying knowledge Sorting information and working things out to make sense		
Eric DH, KI	Solving real life problems by applying knowledge Using skills to apply and fathom things out Looking for patterns Looking and analysing ***Carrying through tasks*** ***Pursuing a line of enquiry*** ***Being methodical, organising their work*** ***Choosing resources*** ***Completing a task***	Talking about what they are doing Recording ways of working ***Keeping records***	Coming up with their own theories ***Predicting then comparing results***
Nell R, MC maths co-ordinator from October '94	Being systematic Checking results Gaining independence Selecting the materials and the mathematics Applying what they know to other areas of maths	***Recording findings systematically*** ***Using appropriate language***	Working things through logically
Olivia Yr 2, WG2	Selecting the materials and the mathematics Organising themselves Being systematic Finding different ways of doing things	Explaining what they are doing ***Recording findings systematically*** ***Talking about their recording***	***Finding patterns and saying what would happen next***

Table 7.2 (contd.) Stranding analysis - 2

Appendix 7b (contd.)

Name of teacher	Applications	Communication	Reasoning, logic and proof
Una Yr 5	Selecting the materials and the mathematics	Recording in their own way *Working collaboratively* *Building on other pupils' ideas* *Being organised in how they set their work out*	Asking "What would happen if...?" *Testing their theories*

Table 7.2 (contd.) Stranding analysis - 2

Appendix 8.

Categories developed by the researcher and used in the mapping analysis of teachers' responses to the mathematics development.

Sitting Tight

I'm carrying on much as I always have. I haven't really done anything much about AT1, to be honest. I haven't made any changes to my practice

Feeling the need

I think I should be doing more about AT1, planning for it and seeing what I can do in the classroom.

Going out to meet it

I've really made an effort to think more about AT1 and to have a look at some activities, but I'm still unsure about what to do in the classroom.

Taking it into the classroom

I've actually tried some activities in the classroom which involve AT1, and I've been thinking about how they have gone, and what the children have got out of them.

Putting it all together

I feel that AT1 is part of my practice. I am including aspects of AT1 in my planning for the other ATs in maths. AT1 is central to my maths teaching.

Appendix 9.

Format of final interviews

I have taken some of the views which you have expressed before and written them here to see if you can say whether you still feel the same way or not. Also whether you think other teachers in the school share these ideas.

Comment	Still agree with this	Don't agree with this any more	Think that other teachers in the school agree with this

Follow-up questions

1. Are there other things you would like to add here?

   Any classroom experiences you'd like to mention?

2. What sorts of experiences for children are you trying to encourage in the classroom?
   (Refer to observation)

3. What progress do you think you have made personally in the implementation of AT1 over the past two years?

4. What do you think has helped you most? (Bank of materials, discussion of maths in meetings, visits of adviser, help from maths co-ordinator, being observed)

5. What progress do you think has been made by the school in the development of AT1?

   What makes you think that?

6. Can you give any examples of what other people have done which seems to have worked?

7. What information do you collect and how do use this in assessing AT1?

8. What do you feel you need to help you personally in future progress with the implementation of AT1?

Appendix 10

Selection of final interviews (summarised)

26	**Olwen**	**23.5.95**
27	**Tessa (IC)**	**23.5.95**
29	**Una (NQT)**	**13.6.95**
32	**Nell (MC)**	**15.6.95**

Olwen **Greenside Interviews 26**

23.5.95

Olwen still agrees with many of her original views, but has noted movement in some respects. She does not feel so overborne by content. She is more aware of AT1 work going on when she hasn't specifically planned for it, and feels that she has changed in this awareness. She feels that AT1 is about more than solving problems, it is also about children getting resources and setting themselves going on a task. She still feels that she homes in on AT1 at certain times *"I still do that, I'm afraid"*, and is conscious of having to correct this. She feels that she is doing more AT1 work linked with other areas of maths, eg capacity, and she is making these links more than she used to. She is also glad of the termly investigations to make sure that they do get the opportunity for this sort of work.

She was cautious about commenting on other teachers' views and said that this was probably guesswork. However she imagines that other teachers would agree with the same statements that she does.

Are there other things you would like to add here?

Any classroom experiences you'd like to mention?

If not assessing, she feels that working with mixed ability groups, the less able benefit. Described making a board game linked with Greek topic on the travels of Odysseus. Children are working individually, less able were able to produce a finished product they were pleased with.

What sorts of experiences for children are you trying to encourage in the classroom?

(Refer to observation)

She wants them to work out their resources, what they actually need, and to work out their own criteria. They should be planning, working out how to go from one stage to the next. She is trying to encourage them to decide for themselves on the order in which they should do things. she hopes that she is making more demands of them.

What progress do you think you have made personally in the implementation of AT1 over the past two years?

Used it more, been more conscious of it, especially now it is in the curriculum documents. (Have to do things now) She is more involved because the school's more involved. Feels she has progressed, but there's a long way to go.

Probe Easier to talk about because the school's more involved?

People more conscious of it all round.

What do you think has helped you most? (Bank of materials, discussion of maths in meetings, visits of adviser, help from maths co-ordinator, being observed)

Ideas have been pooled. When you get the ideas, it doesn't seem so bad. You can see how to do things. Beforehand was struggling to find something at the right level for the children, so that they get satisfaction from it.

Probe on where ideas come from?

Idea for game came from topic work. Next half-term topic is water, hoping to make water clock. Handling data was through Homes and Community.

Feels that she is now seeing these areas as vehicle for AT1 where she wasn't before.

Probe on adviser's visits.
Felt they were more individual ideas, rather than class activities. Felt they stretched the brighter ones more than providing activities for everybody.

What progress do you think has been made by the school in the development of AT1?

What makes you think that?
Change in terms of awareness and practical ideas. Feels that having to do things is a definite prompt.

Probe on levelling meeting Felt that investigation for levelling meeting not very successful for Year 3.

Can you give any examples of what other people have done which seems to have worked?
Really only knows what other year group does.

What information do you collect and how do use this in assessing AT1?
See what they've chosen as resources and ask them about it. Watch the order they do things and see whether they're logical about the order. Feels it's very difficult to assess once it's finished. Finished product doesn't necessarily reflect their thinking. Sometimes have a class discussion, children tell class about it, and she fills in gaps in records.

Probe on whether did this more than in the past.
She probably does. Feels that you've got to be very careful that you're not assessing on their English, rather than the mathematics. Feels she watches the less able more individually, and gets the more able to talk about their work, because they can express themselves more easily.

What do you feel you need to help you personally in future progress with the implementation of AT1?
Would like more ideas for appropriate age-range, ideas linked to what she's expected to cover in maths. Not always easy to see links with maths topics.
Ways of assessing a finished activity when you haven't been able to see them doing it.

23.5.95

Tessa still feels that children have to have some basic knowledge before they can use it and apply it to problem solving. She talked about children with very little number knowledge in Year 1 needing to have something to build on. She thought that teachers higher up the school might not feel this because their pupils had a greater fund of knowledge to draw on. She still feels that they are doing AT1 without necessarily specifically planning for it, in the questioning and talking to children. *"You don't have to do an investigation to find out."*

She feels that some children are muddled by investigations, children who can't work out what they are meant to be doing, who don't work in that way. Some children, she feels, cannot cope with problems, can only see it when it's set out in a particular way. Referring to the Beans investigation which was discussed at the Infants levelling meeting, she said that the teachers had not really been clear in their own minds about what they should be asking children to do, and that this was a key issue for development. Teacher confidence is an important factor. It is only by the process of learning by trying and making mistakes that this confidence can be achieved. She thought the levelling meeting had been invaluable in bringing this issue to the fore, and feels that a similar discussion should be built in for next year.

In relation to planning, she feels that her own planning has been helped by having maths investigations planned into the topic framework. It was a prop to support teachers. She thinks that other teachers feel as she does that planning is easier now and they are better at it.

Are there other things you would like to add here?
Any classroom experiences you'd like to mention?
Not that she could really think of.

What sorts of experiences for children are you trying to encourage in the classroom?
(Refer to observation)
She wants them to think, to challenge themselves, to find different solutions.
That there's not always a right answer, that there could be several answers to the problem. *"Actually what I want them to do is to stop their thinking being in one line, and to spread their thinking out."* She wants them to think mathematically in different ways. That's why she thinks you need to equip them with something to enable them to be able to think in all these different ways. It doesn't necessarily come naturally to them. Teacher has a huge part to play, because unless they're skilful in being able to talk and discuss with the children, they're not going to be able to get the children to think in diverse ways. She feels that she wants children to do this in all areas of the curriculum, not just maths. She compared it with children not being prepared to use reading cues.

What progress do you think you have made personally in the implementation of AT1 over the past two years?
More confident. She doesn't mind so much if things go wrong. She feels it hasn't harmed the children, you can always do it again another way. It's not as frightening as it used to be.
Probe on more enjoyment?
Yes, because she is more confident, she can pass that feeling on to the children.

Probe on planning

She feels it's definitely easier to plan for because they know they're going to do it, going to try some child-led and some teacher-led to give the children guidance. She feels they need not only some knowledge as a basis, but also some guidance in the form of strategies, different ways of recording etc. Wants more sharing of ideas. Ask them to respond to different ways of recording. It is written on plans, and she feels that *"it's amazing how often it does come in to anything that you're doing mathematically".*

Probe more than it used to?

Yes, she feels that she recognises it more, now she's more familiar with it.

What do you think has helped you most? (Bank of materials, discussion of maths in meetings, visits of adviser, help from maths co-ordinator, being observed)

The discussions that have been held about it. The fact that they have had the working party looking in to it, the slotting in of investigations, the levelling meeting. It's been brought more to the forefront.

Probe on adviser's sessions

Would like to have her back to provide more input, now they all feel more confident. Feels you can never have enough. Feels the adviser has the ideas *"dripping out of her, almost!"*

What progress do you think has been made by the school in the development of AT1?

What makes you think that?

Everybody's far more aware, and the fact that it's written in to the curriculum document. So helpful to have it there. It's going to be detailed every half term and that's a great step forward, particularly for teachers who still maybe are not confident or for new teachers. Even if they can't manage to identify it anywhere else, it is actually being done.

Probe whether the element of compulsion is important?

"Yes. Because you might slip back, and think you can't think of anything, but it's there. You can always think of your own in addition."

Can you give any examples of what other people have done which seems to have worked?

This would be interesting because they haven't really looked at what other people have done. Maybe a session to do this would be a good idea. People now have more to draw on.

What information do you collect and how do use this in assessing AT1?

Looking for children's ability to use their mathematical knowledge. Doesn't necessarily have to be recorded, can be through talking. Would be asking them to talk about what they were doing, why, how, how did you come up with that answer, do you think you could do anything else. Questioning skills vital. People don't use them enough.

What do you feel you need to help you personally in future progress with the implementation of AT1?

Input on questioning skills. Keep on doing more and learning by experience. Feels she's quite good at diagnosing where the children are. Needs to get better at identifying where else in maths it is occurring, but feels she has made progress with this. *"Yes, that's much easier now, because you're not thinking of AT1 in a lonely context."* Maybe should be linked in more in the document, but new document is far better, because emphasis is on programmes of study, not on separate statements.

13.6.95

Una still agrees that children should be selecting materials and mathematics but feels that this is quite difficult, the teacher has to set it up well, having everything available. It is also easier if children have done some work in the area before, so that they have some ideas to build on. She is still encouraging different ways of recording - perhaps going through some ideas and different ways first, eg in handling data, and then leaving the children to choose what they think most appropriate. She feels that letting them realise things for themselves is very important - you can always tie things up at the end of the lesson.

She has come to terms with coping with the noise level, is happier now because she realises that they are working but in a different way. *"I've some to terms with it now so I'm much more happy now about having a lesson that is more investigation based so they are going to be making more noise, now that I know they can do it and they are actually working, I think that's what it is".* Still doesn't feel that she's letting them work in an open way on a regular basis, tends to do this in phases. For the majority of the time they are working from books.

She imagines that most teachers have similar views. Thinks that it's perhaps easier in Yr5, Yr6 for children to realise things for themselves. Lower down the school they have to be taught the skills initially, before they can use them to realise things for themselves. Feels also that the pressure isn't there lower down the school to have children working quietly and for extended periods of time. Talked about investigations as a contrast to sitting working quietly.

Follow-up questions

Are there other things you would like to add here?

Any classroom experiences you'd like to mention?

She has been giving number investigations for homework, number patterns, magic squares - which they've then discussed as a class. Because this is individual work (although no doubt influenced by parents) she can get an idea of what they each can do.
Probe on reaction from parents
Not really. Has made effort to explain task, discussed various ways to do it before they go home. Hasn't left them completely without help.

Feels that the children are becoming more aware and realising things for themselves through all the other areas of maths. Feels that they've got to the age when they're taking note of what they're doing, rather than doing something for the sake of it. They are asking questions like "What would happen if I did this?" and she says "Go and try it." Becoming inquisitive about it all and fitting it together almost in their minds.

What sorts of experiences for children are you trying to encourage in the classroom?
(Refer to observation)
Got to learn to think for themselves. Danger with other areas that you are continually saying *"This is how we do it"* and then they go away and do examples and so on. She wants them to be testing things out, not being frightened of doing that. Building on other pupils' ideas. Pupils should have the opportunity of experiencing things even if by the end of it they haven't found a definite scheme of working. She likes them to work

really co-operatively in pairs or small groups to achieve something more than they might have done on their own. Not necessarily something that's going to be right or wrong. Feels it is good for the children who aren't as confident.

Probe on confidence of lower attainers

Has noticed increased confidence with some of them. Have come to terms with what they can do and they can do more now at their own level. She feels that she has got better at realising what children can and can't do and is differentiating better. She had felt very pressured by what there was to cover. Feels she's getting better at using the textbook in a way that differentiates. Also approaches work at different levels for different attainment levels.

What progress do you think you have made personally in the implementation of AT1 over the past two years?

Has become more confident in way she would like to approach it. Has sat down and thought about it because of the presence of the researcher. Feels that was useful. In her first year there are so many things to think about she might not have considered AT1.

Sending investigations home has been useful. It's another way of fitting it in if you can't necessarily get it all done in the class.

Feels happier, but still feels needs to do more. Hopefully next year it would be nice to focus on that more.

What do you think has helped you most? (Bank of materials, discussion of maths in meetings, visits of adviser, help from maths co-ordinator, being observed)

Doesn't feel that she's had that much help, but hasn't particularly asked for it. Other areas have been more pressing. Could have asked, for example, to observe lessons, but has not done so this year. Has learnt through doing things herself. Would feel happy about going to co-ordinator and asking for help if she felt she needed it.

Probe on levelling meeting

Felt that had been very difficult as everybody had presented the investigation in different ways. She had given no help at all, and felt that her children had suffered as a consequence. Still, it had been a learning experience for them all (teachers).

What progress do you think has been made by the school in the development of AT1?

What makes you think that?

There seem to have been phases of doing it. With the investigation, it prompted you to go and do more of your own. In the planning document there are investigations in there, and the co-ordinator has also asked for a list of ones that they have done - that just highlights your attention that you've actually got to do them, and there are suggestions there for you.

Thinks the school is gradually picking up on it. Thinks some teachers do a lot of it.

Can you give any examples of what other people have done which seems to have worked?

Not really, no. Has looked in folder and picked up ideas from there, but hasn't really seen what other teachers have done.

What information do you collect and how do use this in assessing AT1?

How they have set the work out, whether they are organised in the way they do it. Gets them to write down in words how they've gone about something. Looks to see how they're working with others, working equally or one more dominant. Ideally likes to talk to them. Can usually get the most out of talking to them. Combines this with looking at finished work.

What do you feel you need to help you personally in future progress with the implementation of AT1?
Needs to do more investigations to build up own personal bank of things to do - what children find enjoyable, and also to establish progression. Needs to go and ask people for help on how to develop.
Probe on own planning
Identifies investigations on her own planning.

15.5.95

Thinks other teachers are aware now that AT1 applies to a lot more things than they thought it did, that it's not just investigations. Generally feels that other teachers would agree with the things she still agrees with (see cover page), but feels that she is not aware enough of what goes on in Key Stage 2. Monitoring role of co-ordinators is to be extended next year, with opportunities to go into other classrooms to monitor. As Olwen is leaving, and she was going to start the process, the Head has suggested that she should do the maths, starting in Key Stage 2. Will have some time for classroom observations and will be looking at planning, teaching objectives. Looking at delivery of planning document.

Follow-up questions

Are there other things you would like to add here?

Any classroom experiences you'd like to mention?

Found this difficult to answer because AT1 is going on all the time. Concentrating at the moment on getting children to apply what they know to new situations. They get thrown by new context.

What sorts of experiences for children are you trying to encourage in the classroom?
(Refer to observation)

Apart from above, making them enjoy things. Could not think of anything more specific. Asked to come back to that one.

Probed on the things she had indicated already on cover sheet.

She talked about the tractor investigation - colour combinations. Found that no children had approached the task logically, in contrast to the one about the beans (see levelling meeting)

What progress do you think you have made personally in the implementation of AT1 over the past two years?

Thinks she's working in a different way with this class, possibly because AT1 was such a focus here, it has made her more aware of it.

Probe on what way
In last school doing a lot of class teaching, constraints of teaching in a mobile, children were older.

Is happier working in this way, feels that her approach is different.

What do you think has helped you most? (Bank of materials, discussion of maths in meetings, visits of adviser, help from maths co-ordinator, being observed)

Nothing particularly

What progress do you think has been made by the school in the development of AT1?

People are using investigations a lot more now. Difficult for her to say because she didn't know starting point. People are coming to her and talking about investigations they have done, particularly Carolyn. People talking about it more.

Moved away from just investigations.

What makes you think that?
General discussions in staff meetings, difficult to pin down.

Investigations are now in the planning document, set out with ideas.

Probe on whether this was an effective strategy
Thinks so. *"Because it's in there they've got to do it"*, then once they have done it, it gives them confidence a bit more. Also feels that asking teachers for suggestions of investigations that they had done was a good idea. Wasn't imposing things on them, they were already quite happy about doing those ones. Key Stage 1 more forthcoming with ideas than Key Stage 2.

Can you give any examples of what other people have done which seems to have worked?

Not from KS2. Has seen some things from Year 2. Would like to encourage more maths displays.

What information do you collect and how do use this in assessing AT1?

Whether children can use the appropriate language, whether they're accurate in what they're doing, whether they're checking back, working logically and systematically. How they record. She uses questioning to get at their understanding, as well as looking at their written work.

What do you feel you need to help you personally in future progress with the implementation of AT1?

More ideas for investigations, particularly those geared to younger children.

Appendix 11

Selection of fieldnotes (coded and annotated)
(these show initial coding and researcher's comments)

Fieldnotes 4 (extract)	**13.10.93**
Fieldnotes 14	**5.1.94**
Fieldnotes 24	**28.2.94**
Fieldnotes 31	**21.4.94**
Fieldnotes 56	**1.3.95**

Fieldnotes 4 **13.10.93**
(extract)

Infant Maths meeting 3.30 **13.10.93**

The staff meet in two groups for much of their curriculum development, and then come together as a whole staff. There is a coordinator for Infants and for Juniors who both have a certain air of authority, and are consulted frequently by other teachers. AM

The Infant staff meet in Tessa, the Coordinator's, classroom, and the setting - round a large round table - is much more conducive to a meeting than the staff room. AM

Ruth had not been able to do as much preparation for this meeting as she had intended, and was, I think, embarrassed about this because I was there. RES

The meeting took the form, therefore, of the whole group putting together their individual responses to a first attempt at a progression through the Infant Years, with the results being written in to a large grid, which was amended as they went along.

This Infant group seemed a friendly and cohesive group, seemingly used to my presence and all contributing freely, except for the NQT, Tania, who was quiet but did not seem really subdued. There were some definite undercurrents which were dealt with firmly, but in a friendly way. For example, one of the Year 1 teachers Linda, was obviously suggesting coverage that the others thought should be tackled in Year 2, and there were some firm reminders about the importance of practical work from Ruth and Tessa. AM BM PR

This session was obviously in response to the effects of the SATs, the Staff doing what was described in Chapter 6 of the Report - working backwards from what seemed to be expected at the end of Key Stage 1, and deciding when different parts of the programmes of study should be covered. Really establishing minimum coverage for each Year group. ASS

The initial categories on the sheet were General number, Addition and Subtraction, Multiplication and Division, Money, Time, Measurement and Shape and Space, and it was divided into Working towards Level 1 (taken as equivalent to Reception. Level 1 (Year 1) and Level 2 (Year 2). The staff were all quite familiar with the contents of the NC documents and the stranding poster was used to check certain things.

This was a first session, and the staff found things out as they went along. Data handling was added along the bottom; a separate section was decided upon to specify progression in mathematical language and terms (a dictionary was now available, and wecomed by teachers), and calculators were deemed to go right across from Reception. need to be ongoing

Fieldnotes 4 **13.10.93**

There was considerable discussion about the increased importance of number patterns (the algebra was subsumed into the number sections) and about what teachers had learnt from the SATs.

Mal arose in several ways. Ruth said that children should be able to choose the materials they wished to use right from the beginning, and these should be available in each classroom in a clearly labelled maths area. The necessity for this was not questioned, even though some teachers obviously did not have their classrooms laid out in quite this way at the moment.

Tessa stressed the importance of asking children about how they manipulated numbers, and of accepting different ways, and the use of strategies to establish eg number bonds was discussed. Madeleine described how she used to think it was 'sort of cheating' to work out number bonds using a pattern, but now realised that it was a useful strategy, so long as the children understood what they were doing and could explain it to you. She was particularly insistent about children being able to explain things to the teacher, and expressed this view several times.

There were one or two other items on the agenda which were dealt with swiftly. I was struck again by the efficiency of the management, and the acceptance of this by other members of staff. There was no extraneous chat; if there was any sign of drifting off course, Tessa would bring the subject firmly back to the matter in hand.

Fieldnotes 14 **5.1.94**

INSET Day - School Development Plan

I arrived early to find the Head already there, busy setting out chairs in one of the classrooms, since the staffroom was not a good shape for meetings. She explained that the format for this meeting had been tried the previous year and found to be successful. However, she had decided to change the framework slightly, as she felt that it had taken too long last year, and everybody had been exhausted by the end. In addition, governors had been invited to take part in the discussion this time, in an attempt to dispense with an explanation to Governors about the content of the day.

In fact, the two Governors expected did not come, but sent apologies. The people present at the meeting consisted of the entire staff (except Mike initially), the nursery nurses and the full-time school secretary, and me.

Having looked at the programme (enclosed), I asked the Head whether the day would include an evaluation of the previous year's plan. It had been intended that this should take place at the end of last term, but the meeting had had to be cancelled, and would be the first staff meeting of this term. She realised that this would obviously affect the content of the today's meeting. One complicating factor which the Head complained about, but said that she could do nothing about, was the two time-spans for planning - the financial year and the academic year. Some initiatives needed to relate to the academic year, but the finances were related to the financial year.

Teachers had been given priority sheets at the end of last term (enclosed), and had been asked to bring them marked with priorities for review for the next year (ratings 1-4, high to low). Some teachers had obviously given this more time and thought than others (some hurriedly finishing them off!).

Tessa (infant coordinator) raised the point that there was a lot this year that was still outstanding, and people may have marked their sheets in different ways, some including, and some not including those areas. The Head said she was aware of this, but wanted to wait and see what happened with the priorities that people gave.

Carol asked whether they were to assume that everything would fold (ie working groups and initiatives) at the end of the School Development Plan year (in April), and the Head explained that some would fold, but some were based on the academic year.

Mike arrived, apologising for the traffic. It was suggested by the Head that he should set his alarm earlier for the next day, but in a light-hearted, rather than a heavy-handed way.

Fieldnotes 14 **5.1.94**

1. Discussion of personal priorities with Year groups.

The first stage of the discussions were for Year group teachers to compare their allocation of priorities, and negotiate a joint priority for each area. I was asked to sit in with the Year 2 teachers. Their agreement on priorities was remarkably similar across all subject areas. In the mathematics section they gave practical and investigative a '1', and all other areas of maths a '3', indicating that they felt fairly happy about these. Tessa explained that she had given this a '1' because she felt she needed to be doing investigations, but wasn't, and felt she needed more help. She also said that she did feel, however, that the definite priorities in Year 2 were to teach the basics in number, and for children who had not yet grasped these, investigations were a waste of time - 'I think we muddle children up if we ask them to do investigations'. She was very definite about this, and the other Year 2 teacher appeared to agree with her.

2. Collation of whole-staff priorities

The whole staff then came together, and the '1' priorities were collected together. Some groups had been much more sparing than others in their use of '1's, some giving at least 10 areas, some 4 or 5. (At this point I realised, as other areas were being chosen frequently by several groups, that 'practical and investigative' stood a good chance of not being part of the final list of priorities.) The Head then made the decision to take all those areas which had achieved three or more '1' ratings. These were marked, and then discussed briefly in terms of whether they were the subject of an ongoing initiative and would be finished by the end of the Development Plan year, or whether they should be carried over.

Ruth (maths coordinator) and Meg (other member of maths working group) were asked whether they thought 'practical and investigative maths' should be carried over. Both said they thought it could be completed by April, and obviously felt that they had provided a substantial bank of resources, but teachers were not using them. Tessa and other teachers expressed the need for in-class support and more INSET; Ruth asked whether the progression being developed for mathematics would take care of this, but Mary (Curriculum Development postholder) felt that it should be left on the priorities list. It was also mentioned by the Head that this was one of the areas noted by Ofsted as needing attention, and so should be retained. The two areas causing most anxiety were science investigations (Sc1) and continuity and progression in planning, both with six '1' ratings. Data Handling also fell into the group with at least three '1' ratings. (Data Handling is actually on the projected plan for 1994/5.)

Certain areas were regarded as likely to be completed before April, (eg Presentation of work, playground) and these were crossed off the list for review.

Fieldnotes 14 **5.1.94**

The final list of areas for review in the next Development Plan, given below, was established before the coffee break, and then the staff reassembled to discuss objectives for each area. Last year this had been left to the working groups to do, but the Head had decided to try with the whole staff brainstorming to establish objectives, which working groups could then work on in more detail.

Reading	Writing
Infant Library	Junior Library
Data Handling	Prac/Invest. maths
SEN	Equal Ops
Curriculum Planning (inc. Topics, continuity & progression)	
Investigational science	Role of Coordinator
Parents as Partners	Behaviour
Buildings	

3. Discussion of detailed objectives for priorities

This discussion involved almost all members of staff to some extent. The Deputy Head, Eric, acted as scribe, and took notes of comments which were then read back to the meeting. It was noticeable that the members of the management team were the most forthcoming with comments on the whole, but the atmosphere seemed very positive, and all comments were taken seriously, with no jibing or negative remarks at all. I think the fact that each member of staff has a subject area of responsibility, or is a shadow for one of these, and in addition is a member of at least one working group, meant that each teacher has a base of experience or expertise from which to comment. The Head was careful to make positive comments throughout about ongoing work on the areas if this was relevant, praising people's hard work.

Individual comments are given to indicate some of the concerns felt about practical and investigative maths, and data handling.

Practical and investigative maths

Eric: 'People still feel uncomfortable with this.'

Liz: Do we need a definition of what it is?'

Tessa: (referring to in-class support) 'It would be nice to observe them doing it.'

Eric: 'Nobody has really actually told us what they were.' (prac & invest.)

Liz: 'Does what you're already doing come into it' (referred to the interview with me, in which she came to realise that there were some things which were already going on in her classroom which were part of AT1)

Meg: 'It's like in Technology - you may be doing it along the way.'

Karen: 'It's difficult to assess it.'

Mary: 'Assessment is the most difficult in Ma1 and Sc1.'

Eric: 'People feel uneasy, because the situation is unstructured, and they feel they're losing control. Can they organise in a different way?'

Head: 'That could be part of classroom INSET.'

Ruth: 'Organisation of resources in classrooms must be looked at.'

The role of the Deputy Head was interesting in this session. He seemed to be voicing anxieties in general terms so that staff could identify with these, but not necessarily make the points on their own.

Data Handling

Mary: 'There's a tie-in with IT and maths.'

Meg: 'There's a lot of data handling that's not necessarily on the computer. And not necessarily maths - other subjects.'

Liz: 'How do you do it?'

Meg: 'Take the progression through the National Curriculum.'

Ruth: 'This is incorporated in the scheme of work.'

The Head summed up the remaining discussion, saying that emphasis should be given to accessing information, cross-curricular aspects of data handling, and progression at KS1 in particular.

5. Establishment of working groups

After lunch staff were asked to volunteer for working groups to meet regularly throughout the year and discuss the areas under review. The Head had indicated to me previously that she hoped that all members of staff would contribute equally this year, rather than leaving most of it to a small group of staff. This appeared to be happening, although I had no idea which staff had been less cooperative the year before. I found it quite impressive that all staff were prepared to be on at least three working groups, and some on more. In each case the curriculum leaders provided the core of the group. It was noticeable that the maths groups received the fewest volunteers (which might well have been affected by my presence) and several calls had to be made for volunteers. The Prac/Investigative group for April onwards

consists of Ruth, Meg, Tania and Carol; the Data Handling group of Ruth, Meg and

Valerie (teacher returning to Year 4 from maternity leave, and replacing Carolyn).

The Head then set several groups going, as many as could work without leaving out members of staff, asking them to concentrate first on wording the objectives for the Development Plan, bearing in mind the whole staff discussion.

I sat in on both mathematics working groups.

Data Handling Working Group - Ruth, Meg, Valerie

Meg was concerned that people were viewing data handling as only relating to the computer. She went to get her copy of the Ma5 for reference. All three members of the group felt that people needed to know different ways, and needed a lead in how to use them. Ruth talked about the difficulty of finding meaningful data to collect, and then the most relevant way to represent it. Valerie mentioned the importance of children being able to interpret as well as record data. They agreed on three objectives:

> **•Raise staff awareness of different ways of collecting, collating and interpreting data, with reference to the new maths guidelines** (being prepared by Ruth).
>
> **•Try to identify opportunities for data handling within the topics.**
>
> **•Introduce staff to relevant software available.** (Meg is also responsible for IT, and has now some new software available, particularly for new computer in Infants.)

Practical/Investigative Maths Working Group - Ruth, Meg, Carol, Tania

Ruth and Meg obviously felt depressed that after their efforts in organising resources, with a 'bulging' file of ideas for investigations for staff to use, that people still felt they needed more ideas. They read through the objectives for the current year, and felt that several of these had been achieved, or were in train.

After talking about this need for investigations for a short while, Ruth seemed to be musing about this 'practical and investigative maths' and said that Ofsted had picked up that the children were not using the practical skills. Meg asked what staff perceived their problems to be, and Tania replied:

'People are scared of investigations.'

Ruth: 'It's not - "Do the snowflake investigation because it's Christmas" - it's more than that.

Carol: 'It's that as well.'

Tania returned to the problems with investigations, and said that teachers had problems with setting them up, and this could be helped through classroom support.

Ruth: 'They're not "applying"!'

Carol: "Why not?'

Ruth:'Because it's hard!'

Tania: 'You have to consciously be doing it, don't you?'

Carol: 'I think "practical" is the wrong word. It sounds like the trundle wheel.

All members of the group considered this and Ruth then suggested that the title for this area of development should be changed and become the title of the attainment target, as all the other areas of maths were. 'Using and Applying' instead of practical and investigative maths.

Tania said that children needed to use and apply their maths in doing investigations. The group went on to discuss this new emphasis in terms of the application of mathematics concepts and knowledge in a variety of everyday contexts. Meg said:

'Peak have tried to do it within the scheme, but it has to be more than this, doesn't it?

They decided to ask permission from the whole staff to change the title when they returned, and wrote the following objectives which would hopefully be realised through guidance from the maths adviser.

> **•To increase the confidence of staff in managing investigations in the classroom.**
>
> **•To encourage good practice in applying their mathematical concepts and knowledge in a variety of everyday concepts.**
>
> **•To review the assessment of AT1 maths.**

After we had returned to the full group, Carol said to me:

'I hope you approved of our maths!'

I said that I thought it had been a really interesting discussion, but was quite surprised at this remark, and wondered if it was again a bit of a test, or whether she really felt anxious about my presence.

She seemed to be a confident contributor to the group, during the discussion.

By the end of the afternoon, most groups had met and decided on their objectives. The change in title Ruth suggested was accepted by the whole meeting. The whole afternoon had demanded a considerable amount of concentration, and I was very impressed by the focused nature of the discussions, and the energy and enthusiasm displayed. In the general discussion on objectives, the Head had sometimes reminded staff not to go into detail, and had pulled the discussions back to principles, but the small groups seemed to function in an extremely concentrated way. I'm sure that the structure of the day, with short bursts of time on clearly identified tasks was a key ingredient here.

FM total acceptance of task
HT management of meeting
Am Plan of day

At the end of the day, some staff remained to complete the sheets for the school development plan, adding the sections on staff development required, resources, review process and success criteria.

I was given permission to attend the next two staff meetings, on evaluation of last term's work, and final discussion of the completed sheets for next year's plan to be presented to Governors.

Comments

My own role throughout the day was almost entirely one of notetaker and observer. In the small group situations it was more difficult to maintain this. In the discussion on Mal my opinion was actually asked for:

Res

Meg: 'Come on Alison, what do you think?'

but I said at that point that I couldn't comment. The Head asked me what had happened to make the change in focus suggested, as she was hoping that this would happen, but didn't want the suggestion to come from her, and I said that it had all happened without intervention from me.

Res

I did feel that it was reasonable (and necessary) for me to make some comments at the end of the afternoon, when strategies were being discussed, but I tried to make these rewordings of what other people had said, or references to the existing plan as a basis for proceeding. I would have loved to make some stronger suggestions about the relationship of Mal to the other ATs but restrained myself.

Res.

I felt that this had been a most rewarding day. I heard no negative comments at all, all positive about the benefits of time to discuss things etc. I am convinced that careful planning had added to the day's success, but other characteristics were also in evidence:

FM
AM

> Informal but firm running of the day by the Head, but no sign of dictation as to what should be discussed/given

AM

priority. The most important choice made by the Head was in setting the level of priorities/choices which would receive attention.

Good relations between Deputy and Head.

Knowledge of staff and when to praise

The ability to keep to time, and require other people to do the same. It was quite remarkable that everybody kept to the 20 minutes allocated for group discussion, and no groups were late back.

AM

Fieldnotes 24 **28.2.94**

Report back by maths coordinator on meeting with maths adviser

Ruth described this meeting as a chance for her to talk freely, with the adviser listening. The adviser was in school for a whole morning and Ruth was released for that time. She felt the time had "flown by" and they were still talking at lunch time.

Ruth had shown Eva the progression and the topic framework which she had almost finished over half term. Eva shared her concerns over a year-group format, and felt strongly that the progression should remain in levels. She was apparently very complimentary about Ruth's work, and what she had produced already. They discussed several options for the inclusion of Ma1:

as a separate strand
possibilities for Ma1 to be included throughout
specific investigations

They opted for a joint approach of two and three above. Opportunities for Ma1 would be included wherever appropriate, and three specific investigations would be identified for each year group (i.e. one per term) to provide a context for the assessment of Ma1. It was decided that Ma1 type activities would be included in the topic boxes to give teachers ideas about how to integrate these with their topic work.

Ruth and Eva began to collect investigations together. They will continue to do this individually and do them themselves, and will then moderate them together to decide on their suitability for a particular year group.

Eva's visit had been put back to June, as it was thought necessary to wait until after the SATs had been completed. She would probably have one hour with each year group, with the other year group teacher observing as well, and then talk to the teachers briefly afterwards in break, at lunch time and after school. This was likely to take two or three days, with the concentration of sessions making better use of supply time. Eva would then do a twilight session on assessment of Ma1.

Ruth obviously felt extremely positive about this meeting, and said that she was beginning to see real possibilities for the maths development. It was gratifying to see her confidence so boosted and all her hard work appreciated.

Fieldnotes 31 **21.4.94**

Arrived early in time to get ready without fuss for the observation. The LEA inspector was in the Juniors for the morning to look at maths.

While I was waiting Carol, (outside whose classroom I was waiting) expressed concern about the number of meetings they were having, and how little time was left for teachers to work in their classrooms. She felt this particularly as a job-share.

The first session of the observation (See Obs 2) was based round their interpretations (and Mary's) of the task set. I indicated that I had wondered if any of the children would suggest further squares within those already noted. Mary had not been aware of these possibilities and decided after play to go through the pattern that they had found with the initial interpretation, and then extend the task.

At playtime, Mary and I talked to Tessa (Yr 2, Infant Coordinator), who volunteered that she had tried one of the investigations suggested by Eva Farley (they have been asked to do a science and a maths investigation in addition to the SATs, just for the borough) and how interesting she had found it. The task set was to find out which route from rabbit to rabbit hole was the longest - routes were not straight. Children were told they could use any of the materials out on the table - rulers, tape measures, string, pencils, paper. There had been a great variety of attempts. Children using rulers to measure straight across, ignoring curves; children using rulers to measure segments of lines, then adding the cms together; children using rulers in a similar way but replacing at previous mark and counting on; children using the edge of the ruler (ruler held sideways to page); one child using string, cutting a piece the right length for each rabbit, remembering which was which (keeping them in order) and then comparing the lengths to find the longest. I asked whether children's approaches to the task coincided with her expectations and she said that they hadn't, and that she had been very interested in the results. However, it had taken a lot of teacher time in observing the task. She was keen to try another investigation and Mary was going to come in the class with her to do this.

During the second session with Year 4, the inspector was introduced to me and suggested that any feedback I could give the school would be very valuable.

After the second session I asked Mary about how she felt the activity had gone (Obs 2).

I also managed to see Madeleine, who was very forthcoming, and we fixed a time a fortnight hence to go into her class.

Fieldnotes 56 1.3.95

Arrived at 3.00pm for a meeting of the Infant Staff after school. The Head was out on a course, two teachers were away, so Eric was teaching.

Talked to the secretary to discover that Mary has got a Deputy Headship, and will be leaving at the end of term. AH This will be felt as a great loss to the school

Appointment lists were up for Open Evening next week.

Infant Staff Meeting 3.30 pm

First item on the agenda: finding investigations for each year group (3 per year initially) to form part of the topic planning document.

Present: Tessa, Tania, Nell, Lesley, Olivia, Diana. Madeleine ill

Madeleine away.

Tessa asked Nell to take over this item on the agenda.

Nell began by saying that they had to find one investigation for each term for each year group. Lesley asked if it always had to fit in with the topic, and Nell said *"Not necessarily."* HT Strategy decided upon with adviser

She started the ball rolling by suggesting an investigation about building boats which she considered suitable for Year 2, having used it with this age-group in her last school. The investigation was in the form of a problem in story form in which you stopped at different stages for the children to take it on. AH Co-ord Adopting leading role as Co-ord.

Olivia *"The problem gets harder as it goes on."*

Tessa *"They can work at their own level."* AH1 Positive comment

Olivia asked whether you could stop altogether at certain points, but Nell felt that the story should be finished. She emphasised that pupils from Level 3 to working towards had managed to go right through it, although working at different levels. Olivia said she was happy with that investigation. PR Expressing firm opinions based on experience

Lesley suggested one she knew on Flags, to go with the topic of Our World. Both she and Tessa had used this successfully before. PR. She is not often forthcoming in meetings

Tessa then suggested an investigation about snowmen and buttons and umbrellas which involved combinations. Olivia said that she had an account of a Year group doing this activity, and it gave you a good idea of how it might go. PR Offering helpful suggestion

Tessa was looking at one of the books of activities out on the table, and suggested an activity on handling data, reading it out to the rest of the group. She got half way through and realised that it was just a list of instructions for children to follow. Achieving a clearer idea about Hal?

Fieldnotes 56 **1.3.95**

Tessa *"Oh, it's not an investigation!"*

Diana *"It's far too teacher directed."*

Tessa *"It's a nice activity, but too teacher directed."*

Nell suggested the Teddy Bears Picnic activity with different items of food for the Reception classes. Diana was doubtful about any recording of this, as she had talked to her class about this and they had looked absolutely blank. Nell was quite firm that recording was not needed - that they could use real objects or pictures and arrange these.

They then discussed the Height of the Towers investigation that had been part of the Assessments sent by Eva Farley for Year 2 last year. Tessa said that she had felt that the children got a lot out of it even though they had found it hard to record.

Olivia commented that less able children could build with the actual boxes and compare these. The difficulty was being systematic and remembering what they had done.

Tania suggested doing the towers one at the end of Year 1 when their topic was Buildings. Tessa was keen on this, saying that she would like to do it with her Year 1 class, reminding the others that it was the one that I had observed. Nell said that it could be used for assessment at the end of the year.

They decided to use another of the Assessments sent last year, a Train problem, involving number, and using cubes.

Nell then described another successful activity she had done, making up different fantastic animals. Others felt that they had enough 'combination' problems already and should try to think of a number activity.

Diana asked at this point where they would find the chosen observations, and Nell said that they would be in the planning boxes.

They looked at several others to find another number one. Lesley couldn't quite remember what Eva had done with the matchstick activity when she came. What else did they do apart from making their names? Other combination problems were suggested, like how many ways are there to put on your shoes and socks.

Tessa *"I'd really like to get a number one. The one we did with Eva? They had to record it in their own ways. They had to make groups out of 10."* She and Lesley weren't sure if it had been 2 groups or 3 groups that they had to make.

She remarked that these weren't the only investigations they should do. *"Eventually if you can build more in that would be good."*

They spent some more time looking through resources and commenting on activities they had found successful or liked the look of. Lesley suggested one on giving letter certain numerical values, and making up words with a total value of eg 20. She found to her surprise that she had some investigations in her own resources, and shared these around. They were well received, Olivia saying *"This would be good for reinforcing all the halves work we've been doing!"*

PR

By the end of half an hour, they had selected three for each year group, and Nell had some spares as well.

I left the meeting when they went on to another item on the agenda.

Comments of the observer after the meeting

This meeting had a very positive feel about it (Madeleine was away. She had not been very positive at the last meeting with Nell on the Early Years group).

Nell appeared confident in this group, starting the selection off with one of her own ideas, and being quite definite in her views. Olivia was supportive and generally encouraging.

PR Nell in leadership role here

It appeared to me that Nell's strategy of going from teacher's own strengths ie asking them to identify activities that they had used successfully first, worked well. Although no-one commented on this, they all appeared to have done rather more investigative activities than they might have thought, particularly Tessa and Lesley. The swift identification of an activity that was too teacher directed was also interesting.

AM She later confirmed in conversation that she felt this had worked well

AM(

The effect of the INSET sessions, even if not clearly remembered, was also apparent.

MJ Effect of Inset

Appendix 12.

Teaching strategies and pupil behaviours for Ma1

Teaching strategies from the six Principles for the implementation of 'Using and Applying Mathematics' (Askew et al., 1993))

anticipate useful strategies

'model' strategies

encourage pupils to share methods

plan activities incorporating both Ma1 and ideas from Ma2-5

encourage the search for patterns and generalisations

encourage pupils to find their own methods of solution

build upon pupils' methods, acting as a 'critical friend'

adopt a questioning, listening and observing style of interacting

engage in teacher/pupil discussion

encourage pupil/pupil discussion

create an atmosphere were the children feel 'safe' to offer their ideas

challenge pupils

work with pupils to help them find personal relevance in activities

work with unexpected if it engaged pupils' interest and appeared mathematically worthwhile

encourage pupils to set up mathematical models of real objects or situations

use practical work to provoke mental activity

Appendix 12 (contd.)

Pupil activities from NCC Mathematics Programmes of Study, Inset for Key Stages 1 and 2

Designing	designing/devising a mathematical task
Planning	working methodically checking for sufficient information recording findings systematically using 'trial and improvement' methods using alternative approaches
Selecting	selecting appropriate mathematics selecting appropriate materials and resources
Completing	carrying through a mathematical task to a successful conclusion checking results and considering whether they are sensible presenting alternative solutions
Reflecting	looking back and reviewing progress
Interpreting	interpreting mathematical information presented in oral, written or visual forms
Discussing	describing and explaining work being done
Presenting	recording findings systematically presenting findings in oral, written or visual forms
Generalising	making and testing predictions, statements, generalisations, hypotheses
Proving	defining and reasoning with some precision using examples to test statements or definitions following a chain of mathematical reasoning proving and disproving

Appendix 13.

Selection of annotated classroom observations

2. Mary (CC, KI) - 21.4.94

17. Valerie - 31.1.95

20. Carolyn - 7.2.95

Greenside Observation 2

Teacher Mary, M Year 4 Date 21.4.94 Sheet 1

Class size Group size 6 Other adults

Pupils A, B, C, D, E, F

Intentions of teacher in doing the activity:

The activity selected was one suggested by Eva Farley, maths adviser, finding the number of squares in progressively larger squares (2x2, 3x3, 4x4 etc), which was to be extended to find the number of squares in a chessboard. M felt that she wanted to do something she felt confident with during this first session. The activity would involve number and spatial awareness.

Mary was looking for the following aspects of Ma1

Could the children find the pattern?

Could they take the pattern on?

How would the children choose to record this?

From the teacher's point of view she wanted to look at approaching things systematically, and thought there might be a need to give a strategy, up to a point.

Key to comments:

Pupil activities (from Mathematics Programmes of Study - INSET or Key Stages 1 and 2 NCC 1992)

Teacher's strategies (from Chapter 5, Askew et al, 1993)

Other strategies (Scaffolding project)

Introduction of the activity

Plan activity incorporating Ma1, Ma2 and Ma4

The activity had been introduced to the children in the classroom as something in a game format - like on TV.

Before the lesson, M had prepared an area outside the classroom with a round table and portable blackboard. She had provided squared paper, pencils, coloured pencils and rubbers on the table. The group consisted of 4 boys, A and B working together, C and D working together, and two girls, E and F working together. These were the children's choices. This group was considered to include the highest attaining children in the class for mathematics. M also introduced the children to the tape recorder- *to get their Oh no's out of the way* - before she put it on.

9.10 am

M introduced the activity as problem solving. (B said that he did that at home because his dad wanted him to get in a certain school.) The introduction took place in an informal manner, with children being put at ease.

Said they would be working in two's and would need a piece of squared paper and a pencil. Asked D to go back to the classroom and fetch some rulers.

Drew a single square on the board. Drew a bigger square divided into 4 ie 2x2 square. Children appeared to feel free to make suggestions immediately.

Creating atmosphere where children feel safe to offer ideas

Quarters

Window

M Window or quarters? Right, what I want you to work out, OK, is how many squares there are there?

Children were told they could work it work it out any way they liked, drawing it, etc. Asked to record what was on the board, and how many squares there were.

Encouraging pupils to find own methods of solution

M How many have you got, C?

C Four

Other two groups said four as well.

M Oh that was obviously too hard! So we'll have to start ...

A Oh it's one!

M ..with an easier one, so let's try this one. Draws just one square on the board. Generally agreed that there was just one square. Children asked to draw the one square. Asks how they know it's one. B says because there's only one. M rephrases - *because you can only see one square, OK, look round the edge*. Suggests that they go back to the previous figure, and have a closer look.

B now says that there are five, because there are the four small squares and one round the edge. He is asked to go to the board and show the others by drawing round his squares. M congratulates him, then goes over his drawing with chalk.

Describing and explaining work being done.
Providing positive feedback to pupils

A I should have seen that.

F Well done B.

M then goes over the recording, showing them how to record as a 2x2. Asks what they have to have for something to be a square.

D. Equal sides

M Right, so there's two across and two down. ... Let's try the next one and see how well you get on.

Children start to draw the 3x3 square, working well in pairs and completely absorbed by the task.

A and B We know how many!

Everyone asked to make sure they have written their answers down, *because we have lots more to do.* E is asked to show how many on the blackboard and explain.

Anticipating useful strategies
Describing and explaining work being done

E There's 10 squares because there's (counts up the) *nine small square and one big one.*

M Brilliant, right, so altogether we've got 10 squares. So if we did it with the other one, the way we've done that, we've got nine small squares and one big square all the way around the edge.

Providing positive feedback to pupils
Building upon pupils' methods

M goes through the recording, making sure they know how to write down the 3x3 square. Children all start on the next one.

Modelling useful strategies

D Four, eight, 12, 16 - 17! I've got the hang of it!

M Brilliant, I'm glad you've got the hang of it. ... D asked to explain on board. Does so, drawing round them as he goes. Children clap. M goes through the recording again, focusing on recording a 4x4 square.

Describing and explaining work being done

M Has anybody thought of a quick way so far that you could actually work out how many squares there are, A?

Encouraging search for patterns and generalisations

A 4 times 4 plus one.

M That's pretty quick isn't it? Does it work?

Adopting questioning, listening and observing style of interaction

A If you know your tables, yes!

M looks at the first square *Does it work for this? 1x1*

E No

A Unless it's got something in the middle.

Presenting alternative solutions

M Well we'll have to see, what about this one? They go through the others all together; rule appears to work.

Encouraging teacher/pupil, pupil/pupil discussion

M Now, working on the rule that we've got so far, or the pattern that we've done, OK, you've got 1x1, 2x2, 3x3, 4x4, who thinks they can tell me what they think the next square's going to be? C 5x5.

M C, can you predict, see if you can estimate how many squares there are going to be. C 26.

Encouraging search for patterns and generalisations

Other children all agree. E asked to explain why.

E Because five by five is 25 and plus one is 26.

M Well let's see, let's do it and see if you're right.

Suggesting to pupils to check answers

They continue with the 6x6 square. E very quickly says 37 and explains it by saying if you add 10 and you add one, because if you times 6x6 it's 36 and if you add another one it's 37. M suggests putting answers on the board to see if they can see a pattern. 1, 5, 10 ...

E You're adding five every time! C No you're not.

Using examples to test statements

Children asked to carry on the pattern until they get to a square that is 10 across and 10 down. To estimate first, and then see if they are right. C, D, E and F very engaged, A and B fiddling with pencils.

C is trying to calculate in head for 7x7 - *49*

A 48!

B 7x7 is 49!

M suggests counting to check.

Suggesting to pupils to check answers

C. It's 81, 9x9, 'cos 9x10 is 90, take away 9 is 81. C and D are working very quickly and very well together.

Using alternative approaches

E It's 49 - no 50

M suggests strategies for helping them with the larger tables, using smaller ones and doubling, etc. Asks if they can write down a rule for someone else to follow, when they have finished. C and D working very quickly. A and B reminded not to be silly. Children go on for some time working on sensibly. M repeats advice about using tables they know to make up ones they don't. E and F know the lower tables well, and mental addition of two digit numbers is very quick. C and D know more higher tables. M discusses recording, space on the paper, need for another sheet etc with different groups. A and B are slowing down at 8x8. M shows table method with smaller numbers. M shows C's method for 81 to E and F. M suggests C and D go on further.

Modelling useful strategies

Building upon pupils' methods

Challenging pupils

C and D, working together get 121 for 11x11 by doing 10x11 and then adding 11. They then try 10 x 12 and add two lots of 12. E and F quickly get 101 for 10x10 square.

Using alternative approaches

9.45

C and D sent off for calculators to carry on further. E and F asked to write down their answers.

M asks C and D to look at answers to see if any of the patterns are repeating.

Encouraging search for patterns and generalisations

C suggests looking at differences to find a pattern. M remarks to me that they have used finding the difference in previous activities. Add 4, add 5, add 7. M suggests that they go on further and then look for a pattern again. C and D have recorded 8x8 square as 63 rather than 65, so do not find that the pattern continues. They are very quick at finding the difference by subtraction.

Selecting appropriate mathematics

Challenging pupils

Looking back and reviewing progress

Making and testing predictions

M brings them all together at the end of this hour-long session to discuss a rule for finding out how many squares. E and F eventually come up with multiplying the width and length of the square and adding one. M encourages them all to think carefully about what they're saying, to think precisely. Asks what they could do if they didn't know their tables. E suggests the method of using smaller numbers which she and F have been using. M asks what they've been doing to double check that everything is right. E and F come up with counting. That is incorporated into a rule. Realise that multiplication rule doesn't work for the 1x1 square.
Children wanting to rub out work are encouraged to leave their working and just write something more if they need to. E and F discuss liking maths, if it's not too hard!

Encouraging search for patterns and generalisations

Pupils sharing methods

10.10
Children asked whether they want to carry on after play and are unanimous in their enthusiasm to do so.
At break time M and I talk about how things are going. I point out the mistake in C and D's results which is impeding their search for a pattern. I also say that I wondered if any of the children would see the additional squares within the 3x3 square and beyond.
11.05 Children very quickly back in place after play.
M tells them that they are going to do some more investigating, and that this time they will need a page each, as they're going to have their own copy, and they should use pen for their writing.
M says that she wants them first of all to look at their answers to far and see if they can come up with a pattern between them. They go through what they have found, she writes it on the board, and C and D realise their mistake for 8x8.

B suggests looking at differences between numbers.

Selecting appropriate mathematics

D We mucked it up! M responds by saying *'Yes you did muck it up! Well, we'll un-muck it now!*

Providing positive feedback

They go through finding a difference increasing by two each time. M asks for prediction when gets to difference of 17. Several children say 19. Encourages them to get this from looking at the pattern. E struggles with this. M then asks what all the numbers are, and gets the response - odd numbers, going up in twos. *so the next one would be?* - Gets 21, 23,. *So if it's 145 add 25 , what?* E very quick with 170. Asks for next number. E suggests 195 (she had added 25 again).

Encouraging search for patterns and generalisations

Making and testing predictions

M What would you be adding?

E Oh no! 196.

M What would you be adding?

D 27

E So that would be 197

M asks for last one. Several children quick to add 29 in their heads. - 226. M suggests adding 30 and taking away one for those who have not yet got there. Suggests that following the pattern is easier than working out 14 by 14 and adding one on. **Modelling strategies**

M asks for a title for the challenge, for their recording.

A suggests the Square Challenge

E suggests Uneven Numbers

M Wouldn't it be - How many squares are there in a square? so that's going to be your title.

This time the children are asked to look for additional squares inside the ones they have done already, and mark the squares with coloured pencil. M asks them to think logically and record neatly. Emphasises that they should do the different sized squares in different colours. At this point the children are re-recording their previous work.

M 2x2 How many squares? - Five - Is that all that we can see?

B Should be all we can see!

They look at the 3x3 square. M asks them to draw another 3x3 square underneath. They ask why, she doesn't tell them, just asks them to do it. The children suggest that as they are doing it for others, this additional square is for them to work it out themselves.

M says: In *that square there are 14 squares.* **Challenging pupils**

E No there's not, there's only nine, there's only 10.

Creating atmosphere where pupils feel safe to offer ideas

B There is so, if you can cut it up into different ...

E Can you cut it up? M says she will give them a clue. Suggests that they should look at the square which they have got before, and asks them if they are bigger or smaller than the 3x3.

B How many of them can you fit in there?

M I don't know, how many of them can you fit in?

B 12.

M takes them through from How many of the 1x1 squares, to how many of the 2x2 squares. Various responses. M asks them to draw them on their own squares.

Working methodically

B Can you join them up together?

M They can overlap.

B Yes

E Oh that's how you get 14 squares.

During the rest of this hour-long session, all children were completely absorbed, even A and B, in carrying this sequence on and finding patterns within it. B realises that they would need to look for 3x3 squares as well, in the 4x4. M asks for predictions, and E and C offer them most readily. M shows them how to be systematic when the drawing of overlapping squares got very complicated, by following along L - R, then top - bottom. She monitors their progress constantly, moving round from one pair to the next to check on understanding and how they are recording. When they get to 5x5:

Making and testing predictions

Working methodically

Checking on progress during task

D Oh No! We've got to do 4s, 3s, 2s and 1s!

M encourages them to estimate how many 4x4s. D and E both suggest 4.

C (Talking about how many 2x2s) *I think there's going to be 16.* (Looks at pattern of numbers) *1, 4, 9 16. So it'll be 16.*

Defining and reasoning with some precision

The session continues, with M helping F who is falling a little behind and not volunteering suggestions, but when asked, seems to be understanding the pattern and be able to carry it on herself. By the end of the session they have been through the pattern of how many of each sized square, and have looked for predictions for the next one up. All children reached the total for a 10 by 10 square. B, C, D and E exhibited quick mental addition of numbers in the tens and hundreds. A and F were less forthcoming out loud, but not necessarily unable to do this.

Checking on progress during task

Carrying through mathematical task to successful conclusion

Reflections of teacher after activity

Mary was very enthusiastic about the way this activity had gone. She felt that the small group set-up had enabled her to identify, and therefore assess, different children's use of strategies, perceptions of patterns, and manipulation of numbers.

She wondered aloud whether she had intervened too much in suggesting strategies and asked me what I thought about this. I suggested that, rather than me making judgements, she should wait and see the write-up of the tape, and then she could make judgements about her own interventions.

Mary also said that she had not anticipated how interesting the activity could be; the number of patterns that had emerged had been a surprise to her.

Greenside Observations 17

Teacher	Valerie, V	Year 4	Date 31.1.95	Sheet 1
Class size	20	Group size:	individual work	Other adults:

Pupils A, B, C, D, E, F, G, H, J

Intentions of teacher in doing the activity:

Valerie said that they were going to do some work on graphs. They were really bad at labelling the axes and putting a proper title. She would be going through this with them.

Key to comments:

Pupil activities (from Mathematics Programmes of Study - INSET for Key Stages 1 and 2 NCC 1992)

Teacher's strategies (from Chapter 5, Askew et al, 1993)

Other strategies (Scaffolding project)

10.50am

There were about 18 children working in the classroom, with some working outside. Valerie had talked to the class earlier in the morning about the importance of titling and labelling their graphs properly. They were initially working on a graph from the Peak textbook which showed favourite lollipops chosen by an imaginary class. These were displayed as columns of different coloured lollipops. They had to copy the graph from the textbook and answer questions on it using the graph to help them. Many children had not given their graphs any titles or labels, and they had to correct this work. When they had finished this they were to work on a sheet which Valerie had prepared in which she gave them some data on favourite biscuits in tally form, and they had to transfer this information onto a block graph.

Valerie was working at a table with B, who frequently finds his work difficult. He had not started the work yet. Several children were still not sure about what they had to do and had to be reminded which graph they were doing.

J *"What do you mean by where it says 'not clear'?"*

V talked to J about the numbers up the side of the graph. It was not clear how the numbers referred to the blocks on the graph. K *"What's the title, 'graph to show favourite lollipops'?"*

Engaging in teacher/pupil discussion

V *"Well, that's what the graph's about. Yes, that'll do."*

J *"And flavours down there?"* (along the horizontal axis)

B was unsure where to draw the lines on his squared paper. Valerie encouraged him to count up how many he needed for the longest column of lollipops and mark this on the axis.

"Mrs D, what do you mean, like the labels?"

V went through again with several children what the numbers up the side signified, and what 'strawberry , chocolate' etc could be called.

I sat beside various children and asked them about their work.

A *"This graph shows lollipops people like the best.*

C *"No, you have to say this* (quotes from Peak). *'Graph to show favourite lollipops'."*

D was redoing her graph because she said that she had got it wrong. She had chosen this time to record the lollipops as blocks rather than lollipops. AM *"So why have you decided to do squares rather than lollipops?"* I couldn't hear the answer, so asked her if she thought this would tell her the same thing. and what one square stood for.

D *"One lollipop."*

11.15am
B had recorded two flavours relating to one square for some flavours and one for others. Valerie explained that he had to make it the same for each one. *"You've got to make the line longer and put it in it's own box."*

K*"Is this the number off children?"*

V *"Is that what it is.? If that's what you think it is, K, then that's what you write."*

One child said*"Sometimes, at home, I get stuck on graphs, if I want to do one on my own."*

V *"Well, hopefully, by the end of this half term you'll be able to teach your mother how to do them!"*

E had been away the day before so was starting the lollipop graph today. He was answering the questions, and able to read from the graph which lollipop was liked most and which was liked least.

Interpreting mathematical information presented in visual form

I sat beside another child who said that he had to write the titles. When I asked why he had to do that, he said 'My teacher says that they could be anything.' AM *"These numbers could be anything, could they? What are these numbers?" "They're to show how many people there are."*

B *"Mrs D, when we get good at graphs can we do a sausage sandwich graph?"*

V *"What do you mean, a sausage sandwich graph?"*

B *"It's when you see how many people like sausage sandwiches."*

V *"What else would be on that graph?*

B *"There would be chips ..."*

V *"So you're doing a favourite foods.?"* She said that if they finished what they were doing, they could do that.

Working with the unexpected if it engages pupils' interests and appears mathematically worthwhile

I went to sit beside F and G. They were starting work on transferring the data in tally form on favourite biscuits to make a block graph. I asked G what the tallies meant.

Working methodically

[...] G *"It means that seven people like custard creams best."*

Describing and explaining work being done

11.35am

G was very quick to count up the tallies and count up the number of squares that he needed to colour in. He described how he was reading off the information to answer all the questions, and had counted up all the squares to get the total number of children. Two axes had been drawn on the worksheet, and when I asked F why he had decided to draw his axes a certain length, he said that he had counted up the squares on the worksheet to see how big he should make his graph.

Describing and explaining work being done

One child had not understood that the cross line on a tally stood for one item. V suggested that she should check the other numbers on her biscuit graph. Children were bringing their work to her, as she sat beside B, to be checked. One child had started her numbering from 1 rather than 0. Valerie praised children's efforts when they had tried hard to correct their work and write titles and labels correctly.

Providing positive feedback

H and 'I' were talking about what they had had to do for homework and how it had made them 'panic a bit' They had had to collect data from home about numbers of windows, doors, chairs etc in their homes and record this. H had 25 windows, and didn't know what to do about making the axis long enough. Her mother thought she shouldn't go beyond 10. She had asked Mrs D this morning, and she had confirmed that she could go up to 25, but she needed another piece of paper to do this. H and 'I' both found it quite straightforward to read off the information on their graphs to answer the questions.

Describing and explaining work being done

Interpreting mathematical information presented in visual form

The class had previously collected data about favourite pop-groups in tally form, and several children mentioned this and seemed keen to get on to it.

Comments of teacher after activity

Valerie commented that many children still needed prompting to label and title their graphs properly. She felt that it was important for them to be able to describe their graphs accurately and say what they showed. They had done a lot of graphs practically, but still needed practice in how to record it effectively. I said that the two children who described their homework to me had been able to tell me very clearly about the problems that had arisen.

Greenside Observations 20

Teacher	Carolyn,	Year 6	Date 7.2.95	Sheet 1
Class size	26	Group size:	individual work	Other adults:

Pupils A, B, C, D, E, F, G, H, I, J, K, L, M, N

Intentions of teacher in doing the activity:
As Carolyn had students throughout the first half of the term, she suggested that I should come in for the first part of the morning when they did mental arithmetic and short written examples as a class.

Today they would be going through a homework from the previous night. They had been set a problem - **An animal lover has 7 pets. Some are cats and some are dogs. Each dog has 5 biscuits, each cat has 4 biscuits. 32 biscuits are eaten. How many dogs and how many cats are there? They had to record how they had arrived at the answer.**

I was able to look at their work afterwards and add more details of how they had recorded.

Key to comments:

Pupil activities (from Mathematics Programmes of Study - INSET for Key Stages 1 and 2 NCC 1992)

Teacher's strategies (from Chapter 5, Askew et al, 1993)

Other strategies (Scaffolding project)

Planning activity incorporating AT1 and AT2
Encouraging pupils to find own methods of solution

8.55am
The children got their homework out. Carolyn asked what answer one child had got. The answer came 4 dogs and 3 cats.

"Who else thought there were 4 dogs and 3 cats?" A forest of hands went up.

"Anybody thought there was something different?" Nobody did.

"Right, how did you get there, A?" A's reply was inaudible so Carolyn repeated what he had said. *"A has just said 'I did it in my head, I don't know I did it, I've just written down the answer. He said I don't know how to write down how I did it. So, how did you do it, B?"*

B " I done the 4 times table up to 12, then I done the 5 times table up to 20.

Carolyn wrote the 4 times table on the board up to 5x4. B said he only went up to 3x4. Carolyn asked him why.. Another child had done the same and read out what he had written

Building on pupils' methods

C *"I timesed 5 by 4 equalled 20, then I timesed 3 by 4 equals 12. 20 and 12 make 32."*

Describing and explaining work being done

Carolyn wrote this on the board. She asked how they knew which was which. D explained how he had done this, but it was too difficult to hear on the tape.

Carolyn. *"Anyone do it differently. E, how did you do it?"*

Encouraging pupils to share methods

E *"I did the 4 times table up to 7, then I did the 5 times table up to 7, then I did each combination until I reached 32." ... I gave each of them a letter and then I did a+h, a+i."*

Describing and explaining work
Working methodically
Recording findings systematically

Carolyn *"And so you kept working it out until you got the answer 32? How long did it take you?*

Engaging in teacher/pupil discussion

E *"Three minutes."*

Carolyn *"Three minutes? You did it really, really quickly. F, I think you actually got it before you'd even written it down. How did you do it?"*

F *"I just started with 7 dogs, then I thought that was too many so I took away three and did it with that."*

Carolyn, *"So you just guessed it"*

Carolyn asked whether anybody else guessed it, but didn't have a lucky guess and had to start again. G said that he had a try that worked out wrong and one that worked out right.

Creating an atmosphere where children feel safe to offer ideas

H said "I done 4x4 and 3x5 and that made 31, then I did 3x4 and 4x5 and that made 32.

Carolyn read out what 'I' had written and said that she'd written it out very well *" There are 4 dogs and 3 cats because if you times 5 by 4 it is 20 and 4 times 3 is 12. If you then add 20 and 12 together you should get 32. So that is how you get the answer of 4 dogs and 3 cats. When you have worked it out you can see that all you could do was take 1 from the 5 which makes 4 and take 1 from the 4 which makes 3."*

Providing positive feedback

Presenting findings in written form

Making statements

Carolyn then asked if anyone had not worked it out at all, who had *"not a clue"* how to begin.

Creating an atmosphere where children feel safe to offer ideas

J said that she didn't know how to begin. Her mum had said that it was all to do with knowing her tables.

Carolyn referred to the original numbers that they had been given of 4, 5 and 32, which were the numbers they had to think about.

K said he wasn't too sure, he'd worked it out using the times tables. His mum wasn't too good at maths so he'd asked his dad.

Carolyn reminded them that she really liked to see all the different ways that they had written it down, whether they had got it right, or whether they had got it wrong, all the ways they had gone about it.

Encouraging pupils to find own methods of recording

E was telling Carolyn what he had done. She told the rest of the class *"E found a way of writing down the tables. If you at this, 32, what are the units for 32, 2, so he went through his tables here to see which units ended in 2, and he found 3 fours are 12. And then 12 from 32 was 20 so he then went to look 20. Well done E."*

Building on pupils' methods

Selecting appropriate mathematics

9.15am
When I looked through the work afterwards there were several other interesting ways that had not been described to the whole class.

L had written *"Because there was 4 biscuits for cats and 5 biscuits for the dogs so I thought of the 5 and 4 times table and first of all I wrote 4x4 and 3x5, that equalled 31, then I did 3x4 and 4x5."*

Selecting appropriate mathematics

Using trial and improvement methods

M had written down dogs cats
111 / 1 / 111 = 32

Working methodically

She tried one combination which made 31 and the second one made 32.

N tried several different combinations and wrote them all out, 5x3, 4x4 - 31, 5x2, 4x5 - 30 etc through 29, 34, 33 and eventually 32.

Working methodically
Using trial and improvement methods

Comments of teacher after activity

Carolyn said that Mary was very keen on this sort of work and she tried to give the same homework. I asked her if she was keen on it as well. She said that she felt that it was very good for the children but she was always a bit worried about the adequacy of her mathematics. I asked how the parents reacted to this sort of homework. She said that *"some loved it and some hated it"*.

Appendix 14.

Selection of Inset Notes

Year 1	**21.6.94**
Year 6	**22.6.94**
Inset Meeting	**29.9.94**

Greenside Inset - Year 1 **21.6.94**

Teacher	Eva Farley	Year 1	Date 21.6.94	Sheet 1
Class size	28		Other adults	Tania, Linda

9.10am

Tania introduces Eva Farley to her class, and says that what they're going to do will be fun, but they will have to work hard.

Introduction of the activity

Eva introduces the activity to the children as something on which she needs their help. She shows them a large Paddington Bear and introduces the idea of Paddington going on holiday to stay with a friend and packing his suitcase.

Tania and Linda are sitting and watching carefully.

Eva goes through the things in the bag with the children and says that Paddington has the following three sets of clothes - red hat, red scarf, red boots, blue had, blue scarf, blue boots and black hat, black scarf and black boots. The problem is that he's not sure if he's got enough outfits and she wants them to work out how many he can make up from what he's got.

Tania intervenes, saying 'sh' because some children are calling out.

Eva goes through the general possibilities carefully. He can wear all the same colour, or he can mix up the colours. She gives an example of a mixed outfit. The children's attention is completely held, and they are absorbed by the story. Eva asks for estimates of how many outfits. Nine, six, 10, 11, 12 are offered. She asks if they could go away and find out, and then asks a few children for ideas about how they will set about it. One child says you could do it with drawing, another in his head, and a third by writing it. Eva passes back these ideas to the class, and restates the problem clearly again.

Tania is worried about the behaviour of the class.

Eva puts paper on the tables, and asks the children to go off and try and solve the problem for Paddington.

Linda sits with a group, and is asking the children about the hats and scarves and boots that they have drawn. Eva intervenes with some children who have not really got started to suggest drawing something or writing something, or a diagram. She also says "Would coloured pencils be helpful?"

The children are all engaged in the task and the noise level drops.

9.40am
Eva goes through individual outfits with some children, breaking the task down into outfits for different days. E stops them all and describes a strategy that one child is using, taking them through the days of the week. L is asking children what other outfits they can find. Some children are drawing the clothing, some are drawing bears in different outfits. One or two children are getting the idea of changing one item.

Many of the children are preoccupied by the other clothes that Paddington is wearing, and are adamant that a dressing gown is the only possible outfit for breakfast in the morning.

Tania and Linda are working out the problem themselves and comment that it is very difficult. They are focusing on the end product. T says she has found 24 ways. She goes through changing one item with a child, saying "What about if he had a different coloured hat on?"

9.55am

The children are asked to go and sit on the carpet to talk about what they have found out. The children have rather lost concentration, and T is worried again about the behaviour and is reprimanding one particular child. The children are asked to write the number of days Paddington could stay. They do not seem to be relating these days to the drawings they have made of the outfits.

Reactions of teachers after the Inset activity

Linda felt she needed to stay with her class in assembly, as they were a bit lively after having a supply teacher.

Eva and Tania discussed one child who is used to recording formally across the page, and who was not comfortable with recording pictorially downwards. E mentioned that you can learn a lot about children when they are confused. Tania remarked that it was enlightening to see them choosing their own way of recording, and that she had learnt a lot from seeing them doing it. She asked how you could extend the activity, and Eva described a similar activity with foods. Tania said that Linda was going to do the activity with a bear that doesn't wear anything but scarves, hats and boots, so that the children do not become too distracted by other garments. Eva suggested starting this type of activity in September, in a simpler form, perhaps using cut-out hats, scarves etc, or pre-prepared pictures of bears for the children to colour in. She said that she had considered using pictures this time, but decided to see what the children could do with their own recording.

Tania commented that so many of her class think of maths as sums, but she obviously felt that this type of activity was valuable. Eva suggested that if it was her class, she would come back to it during the week, rather than continuing longer at one session. She also said that she sometimes did this type of activity communally, and that individual children often began to offer strategies which could then be taken up by others.

Eva asked where T got her ideas for activities from. T said that neither she nor Linda really used the scheme, but got ideas from their own heads, or from books. She did not feel that they had any investigations to draw on. Asked about UAM, she felt that she usually did this on the carpet, and cited the example of estimating, which she had done recently.

In the staffroom afterwards Linda said that she felt the children had enjoyed the activity, and that they had been quiet, working at their task.

Greenside Inset - Year 6 **22.6.94**

Teacher	Eva Farley	Year 6	Date	22 6.94	Sheet 1
Class size	26	Group size		Other adults	Meg, Liz

Pupils A, B, C, D, F and others

Nim's Game

9.10 am

This activity took place in Meg's class (judged to be the more difficult of the two Year 6 classes). Eva (E) introduced the activity by asking the children (who were sitting at tables) about games that they enjoyed playing, and about winning and losing and cheating , and whether the games they suggsted involved luck or skill.

She then introduced Nim's game, saying that they would need 20 sticks and a bottle top between two people. The bottle top was the poison: the aim of the game was to leave your partner with the poison. When it was your turn, you could take either 1, 2 or 3 sticks.

Sticks and bottle tops were distributed round the room, and the pupils were asked to play one game and then they would talk about it.

Meg and Liz were watching closely to see how different children approached the game, and Meg in particular (it was her class) was rather appalled that two sets of two pupils were taking 20 sticks each, rather than 20 between them.

When all pupils had been encouraged to get this right, and had been given time to play a few games, Eva stopped them to talk about it, and asked for theories about how to win the game.

A (a girl)'s theory was that whoever went first, would lose. Eva asked them how they could check out her theory. She asked how many went first and won, and asked if that helped to test the theory. B (a boy) said that his theory was that to win, you had to leave your opponent with 4sticks. Other children thought 5 and 6.

9.30 am

Eva asked the children to play the game again and write down a theory of what they had to do to win. They were given 20 minutes before they would stop and swap theories.

Two pupils, C and D (boys) had not really taken the possibilities of the game on board. They had divided the sticks in two and were taking one each until one or other of them was left with the poison. With a bit of intervention from E, they began to realise that they could take different numbers.

Meg and Liz were moving round the room asking children about their theories and talking together about what they were seeing. Meg was trying to encourage B to extend his theory of being left with 8 (from 4) still further.

E was also circulating, asking children about their strategies, giving ideas to others by saying things like "F is going to keep a record of a particular game". C and D took up this suggestion. "Shall we do that?"

All the children in the class were completely absorbed in the task. All conversation seemed to be task related.

9.55 am

Eva then stopped the pupils, and began to discuss strategies, valuing each child's contribution. The atmosphere in the classroom was extremely cooperative: children listened to each other's ideas politely and carefully and were able to argue productively with each other. Even the contributions of the low attainers were welcomed and given status. Children were very prepared to talk about what they had done. Child A suggested working back from 4 to see what was needed and several children supported the 'working from 4' theory. E was asking for ways of testing theories, particularly as to whether it was better to go first or second. Most children thought that it didn't matter whether you went first or second.

Two pairs showed the others how they thought you could win by going first, and then by going second.

10.10 am

Assembly. Liz had to go and play the piano for assembly, so was unable to comment afterwards to Eva. I talked to her later in the staffroom.

Reaction of teachers after the Inset activity

Eva began the discussion with Meg by saying that the session showed some very good points about her (Meg's) own practice, as these class discussions were often not possible to maintain, with children listening so carefully to each other. Meg said that she felt that the class had done really well and the game had been a good activity for them. Eva commented that they were all on task. They discussed the fact that even the two low attainers, thoughnot really formulating strategies, had learnt how to play the game, and were absorbed in the activity.

Meg said what she had found really valuable was having another grown-up in the classroom to share things with, something you couldn't normally do. She thanked Eva for the session and for such a good activity.

I spoke to Liz in the staffroom at lunchtime. She said she was amazed that such a simple activity could provoke so much mental activity and was keen to try the activity with her own class. She had also been impressed at the sensitive questioning of the whole class, and that Eva's approach had set a respect for other people's opinions from the whole class. She also had noted the way that Eva had dropped in themes and challenged children, and that she had initiated responses from nearly every child. She felt that all children had been able to participate at different levels.

Inset Meeting - 29.6.94 Sheet 1

Led by Eva Farley, LEA mathematics adviser

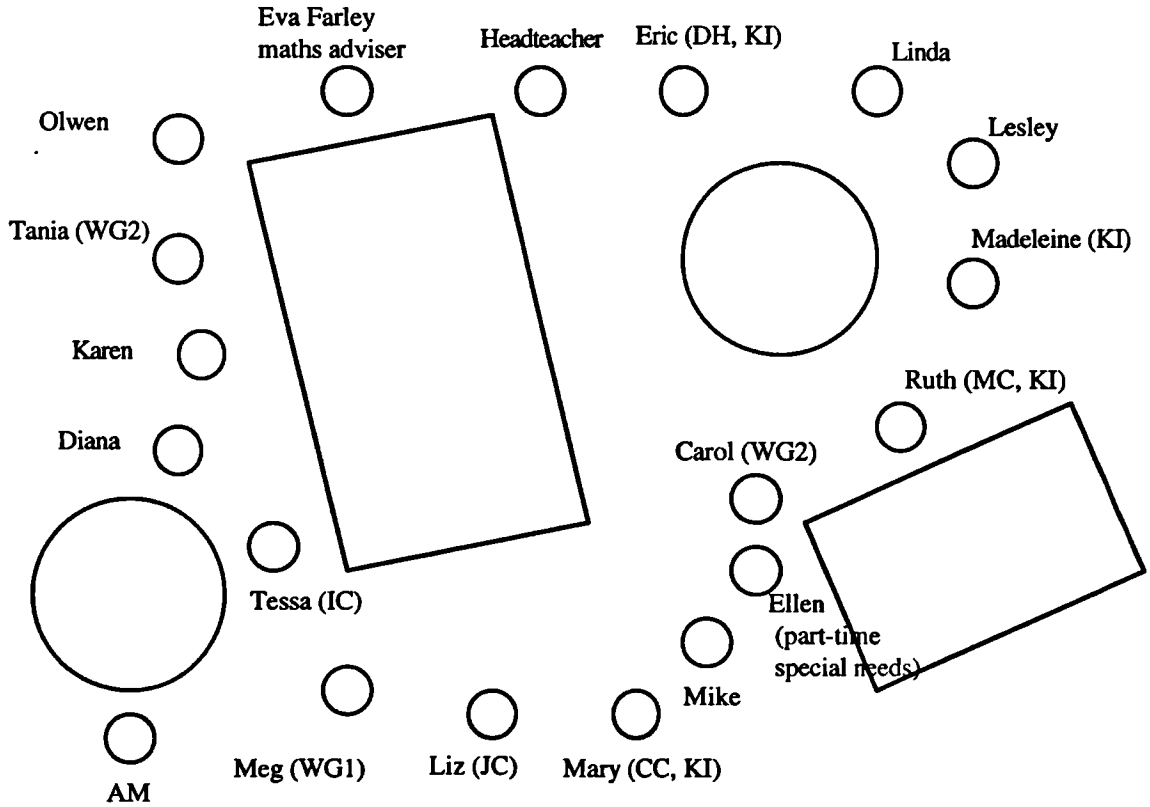
Introduction

This meeting was held in one of the Infant classrooms - a decision made by Ruth (MC, KI) because she didn't know whether Eva would want teachers to be doing activities, and therefore need tables. Although she didn't need tables, Eva was obviously pleased not to be holding the meeting in the staffroom, which she had observed before did not lend itself to meetings.

All the teachers except Ursula and Valerie were present. I didn't establish the reason for Ursula's absence; it may have been another interview, as she is applying for other jobs. Valerie is still ill. The atmosphere was extremely good-humoured and positive. These teachers seem to feel a good relationship with the maths adviser, and were clearly interested in what the meeting would entail.

The arrangement of the room was rather a hotchpotch of tables, with no clear rows or groupings, except for the Head and Deputy who had no table in front of them, and who were next to Eva. I was sitting at a table slightly behind the group. Everyone else could see Eva clearly.

Seating arrangement



The meeting lasted from 3.45pm to 5.00pm. Several teachers lingered to talk afterwards to each other.

The Meeting

Eva started off by saying that the purpose of the meeting as she saw it was to talk through some of the work that had been done the previous week - to look at how they might be incorporating Ma1 in their mathematics teaching: how they could identify it, and how they could do it.

Eva introduced the books on Using and Applying Mathematics produced for the NCC by Brown, Askew, Prestage and Walsh (Brown et al, 1992), saying that she found these extremely useful, and that they were aimed not only at individual teachers, but also at coordinators trying to provide suitable INSET. These were the books that I had lent to Ruth earlier in the year, and which the school had now purchased.

Eva said that she had found it hard to come in and conduct sessions, not knowing the classes, and especially, she said, as I was there with my tape recorder! She asked individual teachers to describe what had gone on in each class, and they were very willing to do this. Eva was quick to point out things which had not gone well, for which she blamed herself, as well as things which had gone well, for which she generally praised the children or the school.

Eva and Diana together talked mainly about working with the calculator in the Reception class (See INSET notes Reception). Madeleine made few comments. There was general agreement that the session had been a bit too long, and that teachers with their own class could make it shorter. Eva described the end of the activity, in which the children were asked to draw pictures of themselves with a speech bubble saying the largest number they knew. She saw this activity as investigating ways of working with calculators and numbers. For example, one child gave 62 as the largest number. Eva gave her a number line to see where she looked on the number line, and whether she could give the numbers above and below 62. *"The great thing about AT1"*, she said, *"is that you can hook it on to another AT"*.

Eva described the Paddington Bear activity (see INSET notes Year 1) as a disaster. She liked activities which provided opportunities for 'what would happen if?', 'how many ways?', but in this case Paddington had taken over the activity with the children focusing on his glasses and pyjamas! There was a great deal of laughter over the activity, with Linda and Tania both enjoying talking about it. Eva went back to the 'how many ways' question, saying that this was a good question which could be applied to numerous situations, and should really be given a much longer time-span. Teachers really needed a week to do it.

Tessa described the Year 2 activity, of putting children into groups, and then asking the pupils how many different groups you could make with 10 children (see INSET notes Year 2). Eva remarked how interesting she had found it that they had all recorded with numbers, having been told that they could record in any way they liked. Lesley intervened to say again that she would have been very surprised if they had not. Tessa felt that there would be a greater variety of recording in her class, and was going to try this activity with them. She had also noticed that the children kept coming back to combinations such as 3, 3, 4, and were reluctant to say, for example, 8,1,1. Some children had changed the order of the numbers and insisted that this was a different way. There was agreement between the two teachers and Eva that the least able had probably got the most out of it.

Mary was then asked to describe the Year 4 session, in which the children had been given two 2p coins between each pair, and had been asked to find out initially how many 2ps it

would take to cover their table. Mary described the different strategies that had been used (see INSET notes Year 4). Eva commented on the group who had broken the problem down into a smaller problem (how many 2ps will fit on a piece of A4 paper) and was pleased with the variety of strategies which had emerged.

Meg asked what you should do in an assessment, if some children were copying the ideas of others. Eva said that you probably wouldn't use it as an assessment except for the originators of the idea, and would try to use a related idea on another occasion.

Karen described the Year 3 activity, where the children drew out their names with sticks first, and were then asked to make increasing numbers of squares with the sticks. The question they had to answer was how many squares they could make with 64 matches. She described the different strategies that had been used for this task (see INSET notes Year 3). Eva emphasised that one group had been almost completely dis-engaged throughout the activity. Carol volunteered that quite a few children had been lost when the activity was turned round from 'how many matches to make 5 squares?', to 'how may squares can you make with 64 matches?'. This was a point which Carol, Karen and I had discussed in the staffroom after the class activity.

Eva agreed that one of the problems of trying to do something with the whole class was that you could lose the differentiation. The class teacher could come back to into the activity on a different occasion. She said that a useful idea was to have on 'Ongoing Work' board, with questions for children to answer on a postcard and put into a suggestions box. These could then be taken out and the ideas tested. The children could look at other people's strategies, and in this way the teacher was using the children themselves as a resource.

Meg next described Nim's game, the Year 6 activity (see INSET notes Year 6). Meg and Liz were both enthusiastic about this activity, and Meg described her horror when some children couldn't get 20 sticks between them. They felt that children at all attainment levels had been engaged in the activity and all felt that they had achieved something. Eva suggested that the game format might have had something to do with this, and there was general agreement from the meeting that this might have been in important factor in motivating the children.

Meg also described how the children had all listened to each other and nodded seriously. Nobody interrupted - to such an extent that she felt like telling one of her more verbose pupils to shut up! There was much laughter, but Eva emphasised the serious point of how well the children listened to each other and respected each others' ideas, and that she thought this was a great strength of the whole school, and was something for them to build on - encouraging children to talk and share.

Meg said that they weren't particularly good at writing it down. Everyone had a solution, but didn't write it down logically.

Eva said maybe the recording was something that as a school they needed to look at. Children could be encouraged to think about good questions to ask and to develop a style of questioning that was not critical of each other's ideas. This could then be linked with recording.

Eric (Deputy Head) expressed anxieties about planning for progression in Ma1. *"Unlike other aspects of maths it's a different outlook, or is it?"*

Liz *"Activities can be taken on at different levels."*

Karen *"How do you know what the level is?"*

Meg *"How do you assess Year 6 against Year 3?"*

Eric *"Perhaps this has something to do with the recording aspect?"*

Eva *"I think you could tell the level from the recording."*

Karen raised the point that the child's system of recording might be quite sophisticated, and you might not understand it.

Eva conceded that it was really hard to give unsupported ways of doing things. It was tempting to give a 'fill in the box' type of recording. She felt that it was helpful if they could get into a style of recording.

Mary asked whether it was *"OK to have teacher-led strategies for recording - when you help them?"*

Tessa *"It's the listening."*

Mary *"You'd give strategies?"*

Meg *"I would sometimes, yes."*

Eva did not directly answer this point. Eric talked about the strategies which I had drawn out of the observations, and said that the list from the NCC INSET folder (NCC, 1991b) had been useful to him. There was some discussion between Eva and the Head as to whether the school had acquired this folder, and if not, how it could do so. Eva suggested asking for the updated version.

Eva gave out a photocopy of a page from Using and Applying Mathematics (NCC, 1992a) showing the Strands in Ma1(enclosed in cloud-like lines). Liz murmured that if you put soft lines round things they didn't look threatening!

Eva said that a lot of primary teachers read Applications as doing practical maths, and at secondary level, as doing investigations.

Meg remarked *"It's nice to hear you say that you often hook AT1 onto different ATs. It's often linked in to number and algebra. It's quite nice to hear that. You worry that you're not doing it when you are."*

Eva commented that if we could make normal maths teaching more investigative, it would free up the time which we normally devote to investigations; if one or twice a week we looked at our planning document and said "Is there a more investigative way of doing this?"

Meg *"Rather than teaching shape, and then Friday morning problem solving! Aren't there some things that you just have to do? Could you do everything through games?"*

Many of the teachers at the meeting considered this an important point. Eva said that maybe she could, but she was good at maths.

Mary came back to it. *"If you ask them to make a square, they've got to know what a square is."*

Eva *"But how would teach about what a square was. Wouldn't you give them lots of investigative work?"*

Mary *"I don't know."*

Lesley *"You'd say - this is a square.!"*

Mary felt that they wouldn't just grab the idea out of the air, and Mike intervened to say that they had to know what the properties of a square were.

Eva said *"It's the word. I just use them, rather than teaching them."* She gave the example of teacher or pupil saying "I'm thinking of a shape in my head" and trying to describe it. Several teachers were nodding here, taking her point on board.

Eric felt that higher up the school where the content was getting very specific you sometimes just had to tell them - you had to put over certain amounts of knowledge.

Meg said *"You worry about maths because it's so linear."* She looked at Eva. *"You're going to disagree with that, I can see that!"* There was general laughter, and the point was not developed. Meg went on to say that her biggest frustration with her present class was that for half the class, their mathematical understanding was so poor, yet they were too old to be back with using the unifix .

Eva was very definite that calculators were extremely good in this situation and were considered as 'adult' by the children.

Meg felt that investigations were held up because for example their adding on skills were not good enough. Liz added that it was not as if they hadn't experienced this before.

Tessa added that many children leaving the Infants didn't understand adding and subtracting, and suggested *"we should be doing them in a more investigative way."*

Eva kept coming back to the value of calculators, and did not really take up the point when Meg asked whether they shouldn't be teaching long division and things like that. She went back to a previous point of Meg's, and said that it was sad if children thought that they were no good at maths. She made another suggestion for classroom use - a "Things I Always Know" board. Children could build on the things they already knew, and would always know, and could learn new things together.

Carol asked about giving strategies for learning, for example, table facts. Eva replied that we all needed strategies, and that we needed to help children to learn.

Karen felt that calculators were not the universal panacea, and that children invested calculators with mathematical skills, whereas they were, in fact, just another tool.

Eva drew on the experience of the CAN project, and said that using calculators a great deal helped children to understand more about the number system They didn't make children lazy.

Eva then began to draw the meeting to a close. She mentioned that, with Ma1, different strands could be approached at different time. She was anxious about what would happen if Ma1 was subsumed into the other attainment targets. When she was asked for her opinion, she said that she felt that having it separate meant that it was much more in people's minds. If people could hide it, they could forget about it.

She said that she felt that the teachers talked a lot as a staff, and had contributed a lot to the meeting. She asked them to make full use of Ruth's progression, which she considered excellent, and to feed off each other's strengths. Ruth mentioned that there was still the maths topic focus to finish, with associated investigations. Eva re-iterated that they should use their coordinator, and asked about a shadow coordinator. This produced laughter and groans, as this is being discussed in the school at the moment, and the decision has just been made to give every teacher an area of responsibility, rather than have a shadow structure.

Eva to Ruth *"Have you got a shadow?"*

Liz *"Interesting question!"*

Eva *"It's supportive to have a shadow."*

Mary *"I'd shut up if I were you!"*

Head *"No, no you go on!"* (laughter)

Eva concluded the meeting by stressing again what a good planning document it was, and that they should share their ideas with others. She volunteered that when Ruth was away on maternity leave, they could contact her direct for ideas, as she realised how difficult if was for them all to have wonderful ideas about all the areas of the curriculum that they had to cover. This produced a very appreciative reaction, with many teachers hardly able to believe that this was a serious offer. Eva insisted that it was.

Ruth said how helpful it had been to hear all the activities discussed, as they hadn't known what was going on in each class. She asked if there were any more burning issues before the meeting finished.

Carol said they could work out how long it would take them to get home (it was the day of a rail strike), and the meeting ended in a good-humoured way, with the teachers expressing thanks to Eva for coming in to take the meeting.

Reactions immediately following the meeting.

Tessa was talking to Ruth in the staffroom. She was extremely appreciative of Eva's understanding of a class-teacher's position. So many advisers, she felt (including the science adviser in this) were so hooked on their own subject, that they forgot about teachers' other responsibilities. She also felt that her offer of direct help when Ruth was away was really valuable. She said to Ruth that they must make sure that they finished the topic framework with associated investigations before the maternity leave began.

Comments of the observer

In her visits to the school Eva seems to have built up an entirely non-threatening relationship with these teachers, partly, I believe, by focusing on her own inadequacies in a very humorous way. Although some teachers said very little that was specific enough to be recorded, I did not feel that any were not fully engaged, or failed to express things that they wanted to express. Eva used a number of strategies at this meeting to facilitate discussion:

She asked the teachers themselves to describe the activities in their classrooms.

She waited, when asked a direct question, for any responses from other teachers.

She identified things that had gone well in the school, tending to attribute any deficiencies to her own presentation.

She did not take up discussion on contentious points,

She also used strategies to get 'teaching points' across:

She never made suggestions that 'they should do', but rather drew examples from 'her own experience as a class teacher' which had worked well.

She came back to points eg re calculators if she felt she needed to make them more strongly.

She specifically mentioned certain resources if she thought they would be useful to the school.

Teachers appeared to be relaxed together and be supportive of one another. The Headteacher intervened only once.

Appendix 15.

List of teachers participating in the research 1993-96

Teacher	1993-94	1994-95	1995-96
Laura	Headteacher	Headteacher	Headteacher
Eric, DH key informant KI	Deputy Head	Deputy Head	Deputy Head Left April '96
Mary, CC, key informant KI	Curriculum and assessment co-ordinator Year 4	Year 6 Left April '95	
Liz, JC	Junior co-ordinator Year 6	Year 4	Year 5
Meg WG1/2	Year 6 working group	Year 6 Left Nov. '94	
Mike	Year 5	Year 5	Year 4
Ursula	Year 5 Left July 1994		
Valerie	Maternity leave Returned Jan. '94 Year 4	Year 4	Year 4
Karen	Year 3 NQT	Year 3 Left July '95	
Olwen	Year 3 jobshare	Year 3 jobshare Left July '95	
Carol, WG2	Year 3 jobshare	Year 3 jobshare working group	Year 3
Tessa, IC	Infant co-ordinator Year 2	Year 1 Curriculum and assessment co-ordinator April '95	Year 1
Lesley	Year 2	Year 2	Year 2
Tania, WG2	Year 1 NQT	Year 1 working group	Year 1
Linda	Year 1 Left July '94		
Diana	Reception	Reception	Reception
Madeleine key informant KI	Reception	Reception	Year 3
Ruth, MC key informant KI	Maths co-ordinator Early years co-ordinator Nursery teacher	Maternity leave November '94 to July '95	Early years co-ordinator Nursery teacher
Carolyn	Supply teacher Year 4 Sept. '93 - Dec.'93	Year 6 Supply teacher Nov. '94 - July '95	
Olivia, WG2		Year 2 working group	Year 2
Una		Year 5 NQT	Year 5
Nell, MC		Maths co-ordinator Reception	Maths co-ordinator Reception

Table 4.1 Teachers participating in the research

Appendix 16.

Mapping analysis - Figures illustrating comparison between researcher categorisations and teacher self-categorisation

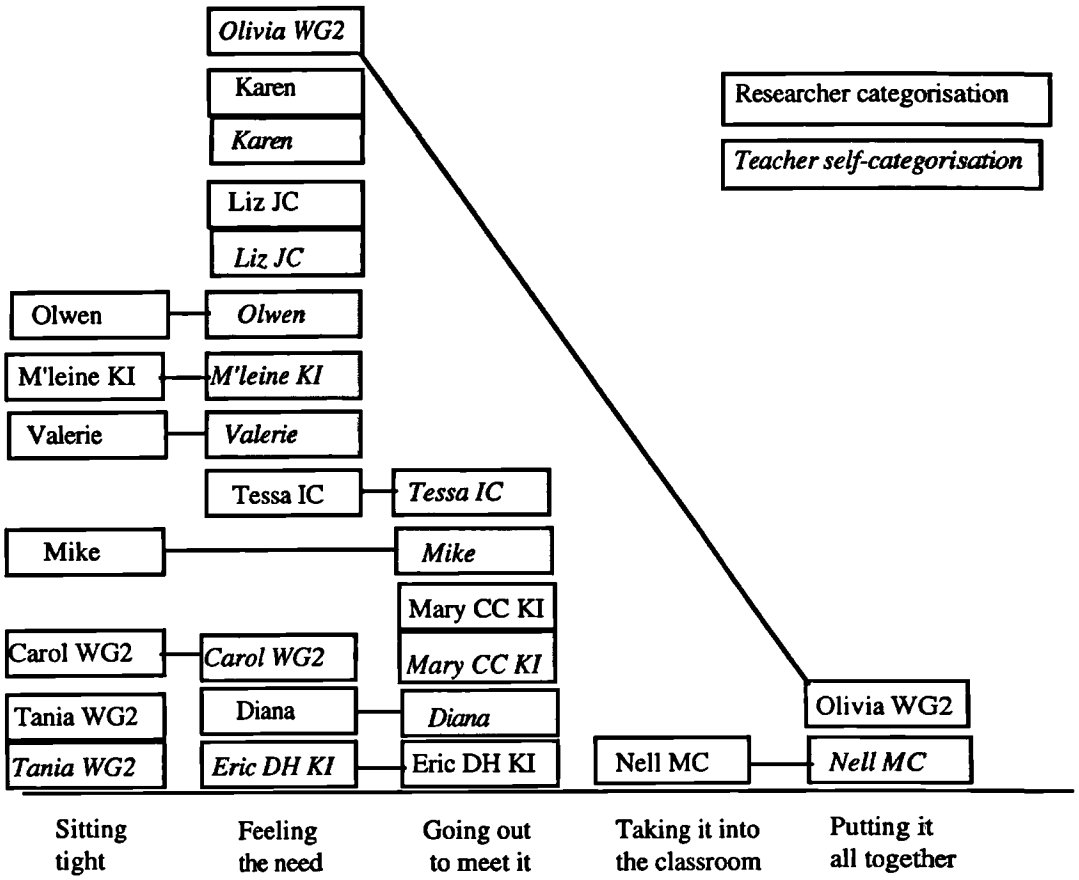


Figure 8.8 Placement of teachers in categories of mapping analysis at the beginning of the research - self-categorisation and researcher categorisation. For three teachers, Olivia, Nell and Una, the beginning of the research was September 1994.

Appendix 16 (contd.)

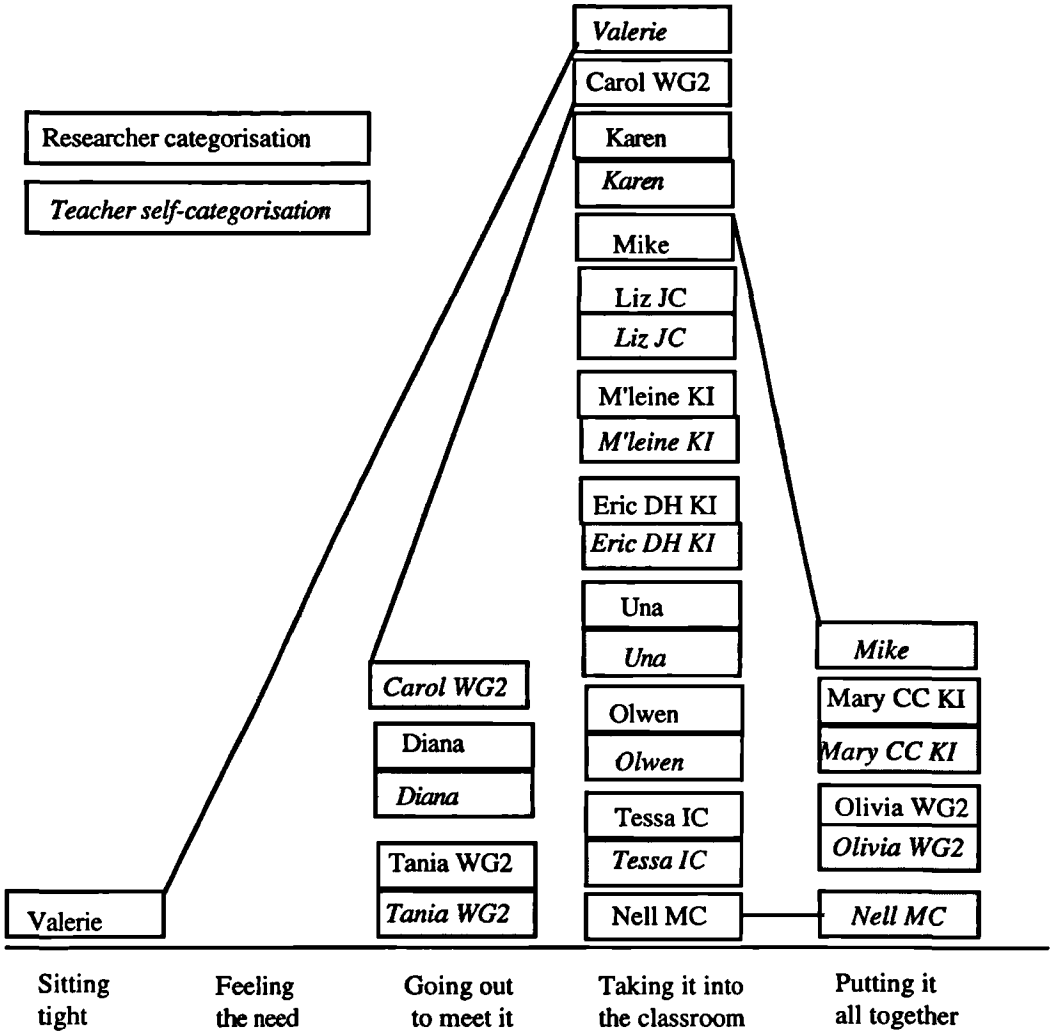


Figure 8.9 Placement of teachers in categories of mapping analysis at the end of the research - self-categorisation and researcher categorisation. For Mary, the end of the research was April 1995.